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MANUAL OF MIDWIFERY

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MANUAL

OF

MIDWIFERY

FOR THE USE OF STUDENTS & PRACTITIONERS

BY

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TO

PROFESSOR ALEXANDER RUSSELL SIMPSON

AND

DR DAVID BERRY HART.

PREFACE.

THE Edinburgh school has recently, no less than previously, been active in the field of obstetrics. Many important facts and numerous interesting theories taught by its teachers have not as yet found their way into text-books. My aim has been to include, in a brief but systematic re-statement of the science and art of Midwifery, as many of these facts and theories as could be compressed into one small volume.

Though, in the first place, a book for Edinburgh men by an Edinburgh man, I hope that it will be found a convenient manual by the members of other schools.

Recent theories on menstruation, ovulation and conception have been stated in Chapter ii. The formation and fate of the deciduae are re-stated in Chapter iii., while modern views on the relation of the ovum to the deciduae and on the development of the placenta will be found in Chapter iv. Thanks to the work of Tait, Bland Sutton, Hart, Webster and others, the subject of ectopic pregnancy has been considerably simplified. Its importance has demanded full consideration in Chapter viii. The mechanism of labour has been re-stated, in Chapter xii., in the light of recent advances due to the study of frozen sections. I have therefore inserted a special chapter on the Sectional Anatomy of Labour, with a discussion of the

third stage based upon sections published so recently as 1892. The use of hot water in haemorrhage has received full consideration. The evolution of the forceps, culminating in the axis-traction instrument, has been carefully described. The question of forceps *versus* turning in flat pelvis has been discussed, as has the use of Walcher's position.

I have entirely excluded the usual diagrams of attitudes and movements which have never been observed, and which owe their origin as well as their depiction to imagination. In fine art, drawing may be employed to express things as imagined and feelings as felt. In science, the pencil may be used to represent things as seen, and, in diagrams, to aid the expression of thought; but not for the presentation of things as they are imagined to be.

My best thanks to Professor A. R. Simpson for his encouragement in my work can only be adequately given in this place; for had I attempted to refer to his lectures, contributions and papers wherever they have afforded me information, I should have been obliged to place a footnote at the bottom of every page. Dr A. H. F. Barbour, Dr D. Berry Hart, Dr R. Milne Murray and Dr J. Clarence Webster have my deep gratitude, for they have been kind enough to read numerous pages of manuscript concerning subjects they have made especially their own. For their kindly expressed approval and invaluable suggestions I am greatly indebted.

Dr Barbour has kindly allowed me to reproduce several sections from his invaluable Atlas. Dr Milne Murray has been good enough to allow me the use of his illustrations of the evolution of the forceps. Dr A. K. Melville has favoured me with the use of his photographs of forceps extraction,

drawings from some of which have already been published by Dr Berry Hart. Mr Fox of Warrington has also aided me with his camera. The other illustrations are from my own drawings. I am indebted to my publisher and his engravers and printers for the careful production of the illustrations.

In a manual like this, errors are almost certain to be present, and I shall be indebted to friends who will point out any which they may notice.

I hope that the book may be a useful, though small contribution to the art in which success can be secured, to use the golden words of an eminent authority, by "a clean shirt every day, careful attention to antiseptics, and a short second stage."

W. E. F.

June 1896.

CONTENTS.

CHAPTER I.

PAGES

STRUCTURE OF THE FEMALE REPRODUCTIVE ORGANS.

External Genitals — Vagina — Uterus — Fallopian Tubes— Parovarium—Ovary 1-15

CHAPTER II.

FUNCTIONS OF THE FEMALE REPRODUCTIVE ORGANS.

Reproductive Life — Puberty — Ovulation — Menstruation — Menopause — Fertilisation — Conception — Nubility — Theories on Menstruation, Ovulation and Conception . 16-31

CHAPTER III

PREGNANCY. CHANGES IN THE MOTHER.

Changes in the Uterus—Decidua—Changes in other Organs —Mechanical effects of Pregnancy—General effects of Pregnancy 32-44

DIAGNOSIS OF PREGNANCY.

Rational or Indirect Symptoms—Physical or Direct Signs— Summary—Chronological Summary—Differential diagnosis—Pseudo-Cyesis 44-56

CHAPTER IV.

PREGNANCY (*continued*). DEVELOPMENT OF THE EARLY OVUM.

Early changes—Earliest human Ova—Comparative Notes— Relation of ovum to Decidua—Development of Placenta 57-70

CHAPTER V.

PAGES

PREGNANCY (*continued*).

Membranes—Liquor amnii—Vesicles of the Ovum—The Cord—The Placenta—The Foetus 71-87

CHAPTER VI.

PREGNANCY (*continued*).

Foetal attitude—Presentation and Position—Multiple Pregnancy — Period of Gestation — Calculation of probable date of Labour — Causes of Parturition — Hygiene of Pregnancy 88-104

CHAPTER VII.

PATHOLOGY OF PREGNANCY. DISEASE IN THE MOTHER.

Epidemics — Tuberculosis — Syphilis — Nervous System—Haemopoietic System—Circulatory System—Respiratory System—Alimentary System—Urinary System—Skin—Reproductive System 105-129

CHAPTER VIII.

PATHOLOGY OF PREGNANCY (*continued*).

MALFORMATIONS OF THE UTERUS.

Development — Comparative — Malformations in Homo — Pregnancy 130-133

ECTOPIC GESTATION.

Development and Course — Causes — Forms of Tubal Pregnancy—Ovarian and Primary Abdominal Pregnancy — Symptoms and Signs — Diagnosis — Prognosis — Treatment 134-150

CHAPTER IX.

PATHOLOGY OF PREGNANCY (*continued*).

DISEASES OF THE OVUM.

Chorion—Amnion—Placenta—Cord—Foetus 151-160

INTERRUPTED GESTATION

Causes — Symptoms — Varieties — Diagnosis — Prognosis — Treatment 160-172

CHAPTER X.

PAGES

Labour. Clinical Phenomena.

Difficulty of Human Labour — Classification of Labours—Phenomena of First Stage—Second Stage—Third Stage . 173-188

CHAPTER XI.

Labour (*continued*). The Factors.

The Powers—The Passages—The Passengers . . . 189-208

CHAPTER XII.

Labour (*continued*). The Relation of the Factors.

Presentation—Position—Nomenclature—Frequency . . 209-212

Mechanism in Vertex Presentations.

Descent of the Head—Flexion—Internal Rotation—Extension — External Rotation — Mechanism in Occipito-Posterior Cases — Summary of Mechanism in Vertex Presentations—Head Marking and Head Moulding . 213-228

CHAPTER XIII.

Sectional Anatomy of Labour.

Before Labour—First Stage—Second Stage—Third Stage — After Delivery — Note on Anatomy of First and Second Stages—Discussion of the Third Stage . . 229-255

CHAPTER XIV.

Management of Normal Labour.

Duties of Accoucheur—Armamentarium—Examination—Preliminaries—Antiseptics—Management of First Stage—Second Stage—Third Stage—After Delivery—Anaesthetics—Summary of Management 256-276

CHAPTER XV.

Morbid Labour.

Causes of Delay in the First Stage.

Faults in I. Powers. II. Passages. III. Passenger . . 277-282

CHAPTER XV. (*continued*).

PAGES

CAUSES OF DELAY IN THE SECOND STAGE.

I. Faults in the Powers—
1. *Accessory Powers.*
2. *Uterus.*

II. Faults in the Passages—
1. *Narrow or rigid Vagina, Vulva or Perineum.*
2. *Distended Rectum or Colon.*
3. *Enterocele.*
4. *Bladder; distension, cystocele, calculus.*
5. *Ovarian and Parovarian Tumours.*
6. *Fibroid and other Tumours of the soft parts.*
7. *Abnormal Pelvis* 282-288

Causes of Pelvic Contraction—Classification—Types of contracted pelvis—Generally contracted—Obliquely contracted—Transversely contracted—Antero-posterior contraction—Compressed pelvis . . . 288-308

8. *Tumours of the Hard Parts.*

III. Faults in the Passenger—
1. *Shortness of the cord.*
2. *Death of the child.*
3. *Large size of the child.*
4. *Unduly ossified skull.*
5. *Enlargement of head or body by disease* (*hydrocephalus, &c.*).
6. *Malpositions of the head* (*occipito-posterior, &c.*).
7. *Malpresentations of the head* (*Brow and Face cases, &c.*) 308-316

CHAPTER XVI.

PRAETERNATURAL LABOUR.

I. Pelvic Presentations—
Description—Management.

II. Transverse Presentations—
Description and Treatment—Hands and feet together—Head and Foot 317-332

CHAPTER XVII.

PAGES

COMPLEX LABOUR. MATERNAL COMPLICATIONS. UTERINE HAEMORRHAGE.

I. Before Delivery of the Child—
1. Placenta Praevia. 2. Accidental Haemorrhage.

II. During the Third Stage—
1. Retained Placenta. 2. Adherent Placenta.

III. Post Partum Haemorrhage 333-361

CHAPTER XVIII.

COMPLEX LABOUR. MATERNAL COMPLICATIONS (*continued*).

Rupture of the Uterus—Tears of Cervix—Tears of Vagina—Rupture of Perineum—Laceration of Bladder—Haematoma—Inversion of Uterus—Circulatory System—Respiratory System—Eclampsia 362-379

CHAPTER XIX.

COMPLEX LABOUR. FOETAL COMPLICATIONS.

Prolapse of Cord—Plural Births—Double Monsters—Apnoea Neonatorum—Intra-cranial Haemorrhages—Tumours of the Head—Fractures of the Cranium—Injuries to Limbs 380-389

CHAPTER XX.

OBSTETRIC OPERATIONS.

Version—Minor Modes—Forceps—*Evolution, Action, Indications, Position, Application and Use* 390-423

CHAPTER XXI.

OBSTETRIC OPERATIONS (*continued*).

Symphysiotomy—Induction of Premature Labour—Craniotomy — Embryotomy — Caesarian Section — Laparo-Elytrotomy 424-445

CHAPTER XXII.

PAGES

The Puerperium.

Phenomena—Management 446-449

Pathology of Puerperium.

Puerperal Septicaemia—*Causation*, *Local Pathological Conditions*, *Diagnosis*, *Prognosis*, *Treatment*—Other diseases of the Puerperium—*Uterus*, *Bladder*, *Mamma*, *Haemorrhage*, *Phlegmasia*, *Embolism and Thrombosis*, *Insanity* 450-465

CHAPTER XXIII.

Hygiene of Infancy.

Care of Infant—Lactation—Artificial Feeding 466-475

Index 477-484

ILLUSTRATIONS.

		PAGE
Plate—	Development of the early ovum (*coloured*)	57
FIG.		
1.	Sagittal section of pelvic organs	2
2.	Coronal and Sagittal sections of uterus	4
3.	Uterus from behind	9
4.	Section of ovary	14
5.	Corpus luteum	19
6.	Sections of uterine mucosa	67
7.	Section of early placenta	69
8.	Diagram of placental circulation	78
9.	Diagram of ovum, cord, and villus	80
10.	Schemes of circulation	84
11.	Diagram of multiple pregnancy	93
12.	Diagram of uterine displacements	126
13.	Diagram of uterine malformations	131
14.	Sections illustrating ampullary pregnancy	135
15.	Diagrams of the forms of ampullary pregnancy	142
16.	Sims' Speculum	167
17.	Hegar's Dilators	168
18.	Fritsch uterine tube	169
19.	Curette	170
20.	Volsella	171
21.	Sound	172
22.	Ovum expelled unruptured	181
23.	Escape of the head	186
24.	Female pelvis	196
25.	Male pelvis	197
26.	Diagram of pelvic axis	199
27.	Diagram of diagonal conjugate	202
28.	Diagram of true conjugate	203
29.	The foetal skull	205
30.	Diagram of rotation	222
31.	Diagram of Caput	226
32.	Diagram of head moulding	228
33.	Winter's frozen section. First stage	231

FIG. PAGE
34. Saexinger's frozen section. First stage . . . 235
35. Chiari's frozen section. Second stage . . . 239
36. Pestalozza's frozen section. Third stage . . . 243
37. Barbour's micro-section of Membranes . . . 245
38. Stratz's frozen section. After delivery . . . 247
39. Scolio-Rachitic pelvis 296
40. Naegele pelvis 298
41. Robert pelvis 300
42. Spondylolisthetic pelvis 301
43. Rickety flat pelvis 303
44. Malacosteon pelvis 306
45. Diagram of moulding in face case . . . 314
46. Waldeyer's frozen section. Before labour (Breech) . 319
47. Chiara's section. Second stage (spontaneous evolution) . 329
48. Straight forceps applied at the brim . . . 395
49. Curved forceps applied at the brim . . . 397
50. Sir J. Y. Simpson's forceps 399
51. Hubert's forceps 400
52. Hubert's forceps applied at the brim . . . 401
53. Tarnier's forceps applied at the brim . . . 402
54. A. R. Simpson's axis-traction forceps . . . 404
55. R. Milne Murray's axis-traction forceps . . . 405
56. Mechanical construction of forceps . . . 406
57. Misuse of Tarnier's forceps at the perineum . . 407
58. Walcher's position 413
59. Diagram of Walcher's position 416
60. Photo of forceps applied 419
61. Photo of forceps traction 420
62. Photo of forceps traction 421
63. Photo of forceps traction 422
64. Barnes' Bag 429
65. Champetier de Ribes' bag 430
66. Simpson's perforator 434
67. Braxton Hicks' cephalotribe 434
68. Braun's cranioclast 435
69. A. R. Simpson's basilyst 436

CHAPTER I.

STRUCTURE OF THE FEMALE REPRODUCTIVE ORGANS.

External Genitals.

Labia Majora and Mons Veneris.—In the erect female the mons veneris is the only visible portion of the external genitals, as the vulva looks directly downward. The pubic hair forms a triangle whose base is upwards, forming a curved line crossing the hypogastric region. A mass of fat lying above the pubic symphysis, forms the mons veneris. Its continuations backward on either side of the vulva are the labia majora. The skin of each labium majus is covered with crisp hair. The inner surface, which lies touching that of its neighbour, is smoother and bears less hair than the outer. Posteriorly there is less fat, and the labia are mere skin folds where they meet behind the vulva.

Labia minora.—The labia minora are two hairless folds of soft skin, not mucous membrane, one on the inner aspect of each labium majus. Anteriorly they meet in the middle line, and form the prepuce of the **clitoris**—the homologue of the penis—which consists of crura, body, and glans, the glans alone being visible. The **vestibule** is a triangular surface covered with mucous membrane. The clitoris forms its apex, the labia minora its sides, and the anterior margin of the vaginal orifice its base. In the centre of the base is the urethral aperture. The bridge of skin behind the vulva is known as the **fourchette**, and is continuous with the thinned-out posterior extremities of one or other

of the pairs of labia. The vaginal orifice thus lies between the vestibule and the fourchette. It is guarded in the virgin by the **hymen**, a fold of mucous membrane narrowing the aperture, which varies greatly in shape and size. This is generally torn at the first coitus, and at parturition is

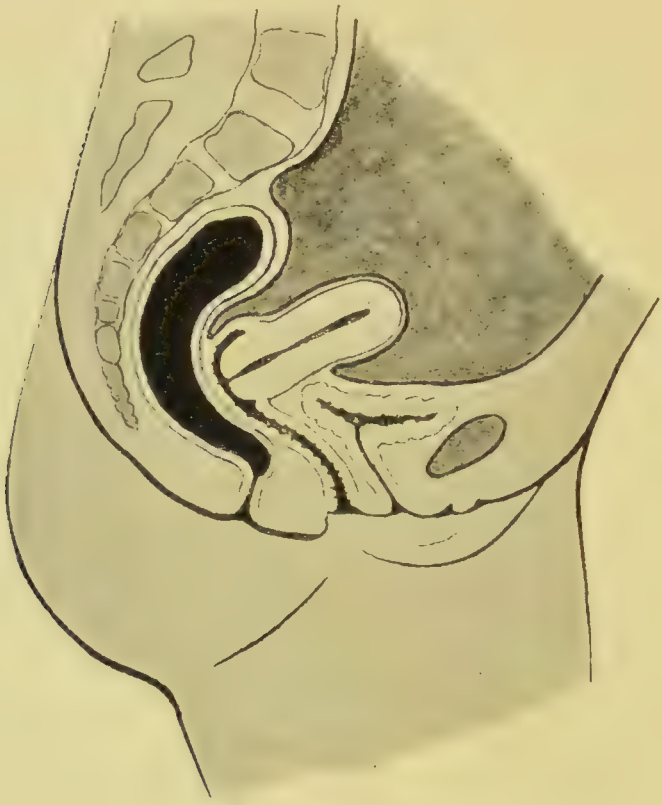


FIG. 1.—Sagittal section of pelvic organs.

further broken up and reduced to irregular projections of the mucous membrane—the carunculae myrtiformes. The small space between the hymen and the fourchette is called the fossa navicularis. The ducts of the two glands of Bartholin open one on each side between the hymen and the labia minora, the glands themselves lying more deeply in the pelvic floor.

Vagina.

The **Vagina** is a sac, wide above and narrow below, whose anterior and posterior walls lie in contact with one another. Its cavity is thus a transverse slit in the pelvic floor, with the anterior vaginal wall, the urethra, and the bladder in front of it, and the posterior vaginal wall, the perineal body, and the rectum behind it. This slit runs first upwards, then backwards, and then upwards again, to embrace the mouth of the uterus, thus having a sigmoid curve. Its general direction is parallel to the brim of the pelvis, *i.e.* at right angles to the axis of the uterus. The anterior wall is 2 to 3 inches long, and joins the cervix uteri at the junction of its middle and lower thirds. Embedded in its lower half is the urethra, while its upper half is loosely connected with the trigone of the bladder, the ureters being in direct relation with it. The posterior vaginal wall is 3 to 4 inches long. Its lower portion is in relation with the perineal body, its middle portion with the rectum, and its upper portion with the peritoneum of the pouch of Douglas. It joins the cervix uteri at the junction of its middle and upper thirds. Thus the vaginal roof encloses a space round the cervix, whose lower part projects into the potential cavity of the vagina. This space is deepest behind, and is divided, for description, into anterior and posterior, and right and left lateral fornices. The orifice of the vagina is nearly circular, and in the virgin is more or less narrowed by the hymen.

Structure. — The walls of the vagina are of connective tissue and unstriped muscular fibre. They are lined by mucous membrane with a stratified squamous epithelium. The mucosa is thrown into numerous transverse folds—the rugae—and has also one or two longitudinal folds—the columnar ridges—on the anterior and posterior walls. The muscular fibres surrounding the

orifice are termed the constrictor vaginae, and are derived from various muscles of the pelvic floor.

Perineal body.—The perineal body is a mass of fat and connective tissue, from which numerous muscle fibres spring. It is in shape a triangle, with its base downward, touching the skin of the perineum between vulva and anus: its anterior side touches the vaginal wall, its posterior side the anal canal. Thus the anal canal runs up for about $1\frac{1}{2}$ inches at right angles to

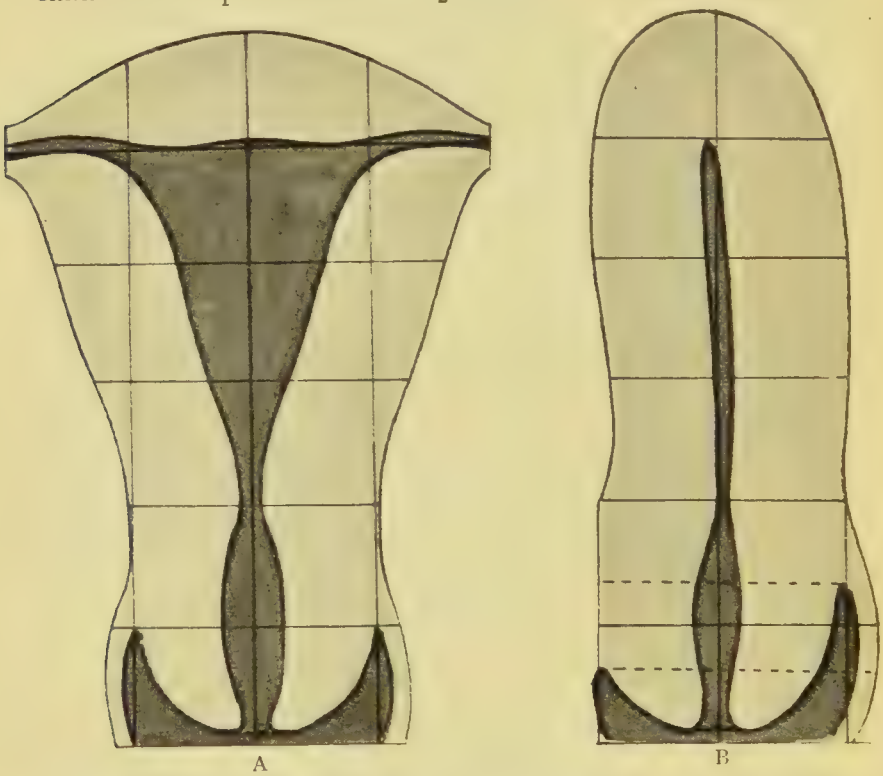


FIG. 2.—A, Coronal, and B, Sagittal sections of Uterus drawn over $\frac{1}{2}$-in. squares to show dimensions of the organ.

the vagina, the vagina and rectum then come into direct contact and lie parallel to one another. When closed, the anal canal has its lateral walls in apposition, so that in a section of the pelvic floor it appears as a mesial slit, the vagina as a transverse one.

Uterus.

The **Uterus** is a hollow body, in shape roughly a triangle with its apex downwards, and an opening at each angle. Anterior and posterior surfaces are described, and superior and two lateral borders. The anterior surface is the flatter, the posterior being much rounded. At the two upper angles are the openings of the Fallopian tubes, between these is the rounded upper border—the fundus. Below the Fallopian tubes are the lateral borders, and attached to them are the two broad ligaments. The truncated lower angle forms a rounded projection into the vagina, in the middle of which the cavity of the uterus opens into that of the vagina at the os externum. A constriction known as the isthmus divides the uterus into body and neck—corpus and cervix uteri. The corpus uteri is further divided into an upper portion, and the lower uterine segment, but this distinction is not plain in the non-pregnant uterus. The cervix is further divided into vaginal and supra-vaginal portions. The uterus is 3 inches long, 1 inch thick, 2 inches broad above, and 1 inch broad below. The cervix is about 1 inch long.

Cavity.—The cavity of the uterus, like that of the vagina, is a potential one only, as its anterior and posterior walls are in apposition with one another. The **cavity of the body** is triangular. It is 1 inch wide and 1½ inches long. At each of the upper angles is the opening of a Fallopian tube; at the lower angle the cavity narrows to the diameter of a uterine sound, where, at the os internum, it opens into the **cavity of the cervix.** This cavity is 1 inch long and is spindle-shaped, as it again narrows before opening into the vagina at the os externum, which is round and just admits a sound in the nullipara, while it is a transverse slit in parous women.

Position.—The long axis of the uterus, in the normal position of anteversion, is perpendicular to the pelvic brim,

and therefore parallel to the axis of the pelvic inlet, though somewhat anterior to it. The fundus is at the level of the brim, the os externum at that of the ischial spines. The uterus lies on the bladder in front, and is in relation with the contents of the Pouch of Douglas behind.

Ligaments. — The two **broad ligaments** connect the uterus with the lateral walls of the pelvis. Each consists of a fold of peritoneum containing connective tissue, unstriped muscle fibres, vessels, nerves, lymphatics, a Fallopian tube, and a parovarium.

The **utero-sacral ligaments** are two folds of peritoneum enclosing connective and unstriped muscle, and passing from the sides of the uterus at the isthmus to the sides of the second sacral vertebra. They thus pass one on each side of the rectum and form the lateral boundaries of the Pouch of Douglas.

The **utero-vesical ligaments** are two similar folds of peritoneum passing from the sides of the uterus on to the bladder and forming the lateral boundaries of the utero-vesical pouch.

The **round ligaments** spring from the lateral borders of the uterus just below the Fallopian tubes, one on each side, between the layers of the broad ligaments. They are bundles of unstriped muscle fibres, ending in tendinous fibres as they pass through the inguinal ring. Three strands are described: one passing into the internal oblique and transversalis, one passing into the superior column of the external abdominal ring, and the third going to a point just above Gimbernat's ligament, and sending some fibres through the ring into the Mons Veneris and Labia majora.

Perimetrium.—The corpus uteri has a covering of peritoneum. This membrane passes from the bladder on to the uterus at a point varying with the degree of distension of the bladder. When this is empty the peritoneum reaches the uterus at the isthmus, but for some distance it is loosely attached, and leaves the uterine surface when the bladder is

full. It then passes up, firmly attached, over the anterior surface to the fundus, thus completing the utero-vesical pouch, which contains no small intestine. The peritoneum passes over the fundus and down over the posterior surface of the uterus on to the posterior vaginal wall, on which it runs for something less than an inch and then turns up again on to the rectum, so forming the Pouch of Douglas.

At the sides of the uterus the peritoneum passes off its surface in the folds forming the broad ligaments, and enclosing the tubes, the parovaria, and the vessels supplying the uterus. Other smaller folds of peritoneum enclose the other ligaments of the uterus. Thus the body in front and both body and cervix behind have a serous investment —the perimetrium; while the cervix in front and laterally is in contact with connective tissue only, as are the two lateral margins of the body of the uterus from which the broad ligaments arise.

Mesometrium.—The muscular wall of the uterus is about half an inch thick, and consists of unstriped muscle and fibrous tissue. It may be described briefly as consisting of—

(1). A thin subperitoneal layer supplying strands that pass into the ligaments of the uterus;

(2). A thick layer of fibres passing in various directions;

(3). A thick layer of fibres running round the cavity of the uterus and forming special muscular rings round its orifices, namely, those of the two Fallopian tubes—the os internum and the os externum.

Endometrium of body.—The mucous membrane lining the cavity of the corpus uteri is $\frac{1}{15}$ to $\frac{1}{20}$ inch thick, but grows rapidly to about $\frac{1}{6}$ inch thick before each menstrual period. It is reddish grey in colour, and is smooth but pitted by numerous small depressions visible on slight magnification — the openings of the crypts or follicles. The mucosa is implanted directly on the muscular wall without the intervention of any submucous layer. It has

a matrix of connective tissue rich in round cells with large nuclei, spindle cells and fibrils. Leopold holds that the strands of connective are covered with a layer of endothelium converting the spaces between them into lymph spaces. This mucosa is covered with ciliated columnar epithelium. The crypts run down from their openings on the surface as far as the muscular wall. Many of them bifurcate, and their ends are frequently embedded in the muscle. They are lined with ciliated columnar epithelium, and continuous with that covering the surface of the mucosa.

Endometrium of Cervix.—There is no definite line of demarcation between the lining of the body and that of the cervical cavity. Here, however, the mucosa is folded to form the structure known as the arbor vitae. There are longitudinal ridges anterior and posterior, with numerous transverse ridges secondary to these running from them right and left. The epithelium is columnar, ciliated on the ridges but not between them. The glands in the cervical mucosa are racemose, and are lined by columnar epithelium. At the os externum this glandular mucosa, with its single layer of columnar epithelium, ceases. The vaginal part of the cervix is covered by dense connective tissue raised into many vascular papillæ, over which is a stratified squamous epithelium. There are normally no glands on the vaginal portion; but in cases of eversion of the mucous membrane of the cavity, there is a more or less pathological spreading of the glands beyond the os externum on to the vaginal surface of the cervix.

Blood supply.—On each side the ovarian artery passes between the layers of the broad ligament from the pelvic wall toward the upper angle of the uterus, supplying the tube, ovary and round ligament. The uterine arteries, from the anterior division of the internal iliac, pass toward the cervix and then up the sides of the uterus between the layers of the broad ligaments anastomosing with the ovarian. Their course is very tortuous. Their primary

branches run superficially over the uterus covered by a few muscular fibres, and give off secondary branches, the curling arteries, which run perpendicularly through the uterine wall and form numerous capillary loops in the mucous membrane. The vaginal arteries, from the anterior division of the internal iliac, also anastomose with the uterine. The internal pudic arteries supply the perineum. The veins are not provided with valves, which adds to the dangers of haemorrhage. Each organ has a rich venous plexus.

Lymphatics.—It may be conveniently noted here that the lymphatics of the external genitals and the lower fourth

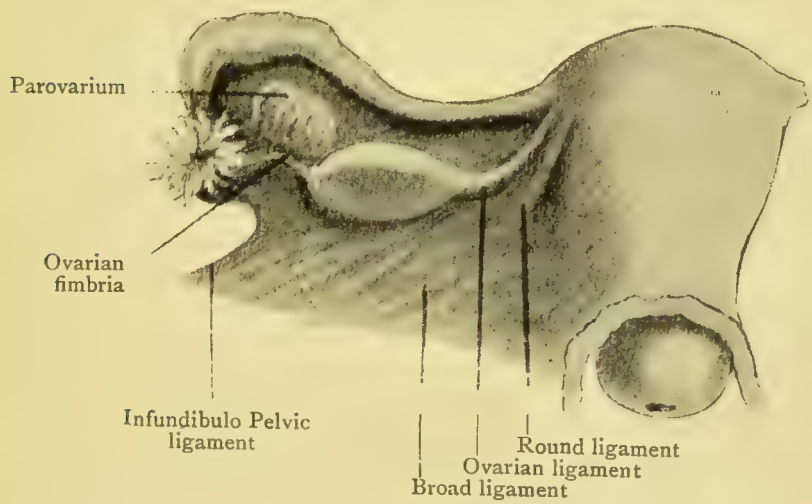


FIG. 3.—Uterus from behind, with left tube and ovary.

of the vagina open into the inguinal glands, while those of the upper three-fourths of the vagina and cervix open into the hypogastric glands. Those of the body of the uterus pass to the lumbar glands. Leopold holds that there are no special lymphatics in the uterine mucosa, but that all the interspaces in its connective tissue are lined by endothelium, and are thus lymph sinuses from which the lymph passes into the lymph spaces and vessels of the muscular coat, and

thus into large lymphatics which leave the uterus with the blood vessels between the layers of the broad ligament.

The **nerve-supply of the uterus** is mainly derived from the sympathetic system. The hypogastric plexus lies between the common iliac arteries, and divides below into the two inferior hypogastric plexuses, which receive branches from the lumbar and sacral ganglia and the sacral nerves. These plexuses supply the uterus, vagina, ovaries, and tubes. Cervical ganglia are also described. The filaments supplying the uterine wall are said to end in the nuclei of the unstriped muscle fibres.

The Fallopian Tubes.

One of the Fallopian tubes runs outwards from each upper angle of the uterus. Each tube is about $4\frac{1}{2}$ inches long, and consists of the narrow straight isthmus next the uterus; a wider portion, the ampulla, which curves over the ovary; and the infundibulum or fimbriated extremity. The tube lies in the upper margin of the broad ligament, so that the greater part of its surface has a covering of peritoneum; a narrow strip on its inferior aspect being in contact with the connective tissue between the two peritoneal layers of the ligament. The course of each tube is first outward, then upward over the ovary, next downward and backward so that its fimbriated extremity lies somewhat behind the ovary (His).

Structure. — Under the peritoneal covering there are layers of longitudinal and circular unstriped muscle fibres. Within the muscular wall is a mucous membrane with ciliated columnar epithelium. The lumen of the tube is stellate in the isthmus, the mucosa being thrown into longitudinal folds. The folds are exaggerated in the ampulla, giving the lumen a dendritic outline in section. Glands in the mucosa have been described, but probably do not exist. The ostium abdominale, or opening of the tube into

the peritoneal cavity, is surrounded by the fimbriae; one of these, the so-called fimbria ovarica, is attached to the blunt outer end of the ovary. The ciliated epithelium lining the tube and investing the fimbriae is directly continuous with the squamous endothelium of the peritoneum —the only instance of continuity between a mucosa and a serous membrane. The intramural portion of the tube passes through the thickness of the uterine wall (half an inch) to open into the cavity of the uterus.

The Parovarium.

This structure, also known as the organ of Rosenmüller, is the homologue of the epididymis in the male. It lies in the broad ligament between the ovary and the ampulla of the Fallopian tube, and consists of several closed tubules lined by ciliated epithelium, which converge towards the ovary and are connected by a longitudinal tube. This connecting tube—the duct of Gartner—is a remnant of the Wolfian duct, and is thus the homologue of the vas deferens.

The Ovaries.

Each ovary is an almond-shaped body, having a flat superior and a more rounded inferior surface. Of the two borders connecting these surfaces, the posterior is free, while the anterior is attached to the posterior surface of the broad ligament. An ovary of ordinary size measures about $1\frac{1}{2} \times \frac{3}{4} \times \frac{3}{8}$ inches, and its weight is about 87 grains. Healthy ovaries, however, vary in weight from 60 to 135 grains.

Position.—The ovaries lie behind the broad ligament at the level of the pelvic brim, each opposite to the sacro-iliac synchondrosis of its own side, about midway between the Psoas muscle and the uterus. The position of the long axis of the ovary varies from the horizontal to that of a

parallel to the spinal column; but usually it runs outwards, backwards, and upwards from the pointed inner end to the blunt outer end of the organ. Schultze gives the position as antero-posterior, Hasse as out and forward, His as vertical.

Ligaments.—The anterior border of the ovary is attached to the posterior surface of the broad ligament by a mesovarium. The unstriped muscle is prolonged into the portion of the broad ligament between the uterus and the ovary below the Fallopian tube, thus forming the ovarian ligament. The infundibulo-pelvic ligament is the marginal part of the broad ligament between the tube and the pelvic wall. One of the fimbriae is usually attached to the blunt end of the ovary—fimbria ovarica.

Structure.—The hilum of the ovary is the part attached to the broad ligament where vessels, nerves and lymphatics enter. The young ovary consists of a central **medullary portion**—the zona vasculosa—composed of connective tissue and unstriped muscle, with tortuous bundles of vessels; and a **cortical portion**—the zona parenchymatosa—which is a stroma of connective tissue containing the Graafian follicles. Each follicle is a vesicle containing an ovum; the youngest ones are nearest the surface, while the more advanced lie deeper in the ovary. This follicular stroma is covered by the tunica albuginea, a layer of connective tissue which becomes dense and recognisable only toward the end of the functional life of the ovary. The cortex and medulla are not clearly distinguishable after puberty, so that to see them a young ovary must be examined, while to see the tunica albuginea an old one is necessary. The investment of the ovary is a layer of cylindrical cells like the epithelium of a mucosa, and quite unlike the squamous endothelium of the peritoneum, with which it is continuous at the hilum of the ovary, a faint white line marking the transition. This layer is the remains of the germinal epithelium (Waldeyer) from which the ova are developed.

Ovisac.—The number of Graafian follicles in the ovary of an infant is estimated at from 35,000 to 70,000. Many of them never come to maturity; but supposing even that a woman sheds 500 ova between puberty and the menopause, there is an excess which can only be explained as a survival of the fish-like fecundity of ancestral types. The follicles vary in size from $\frac{1}{100}$ to $\frac{1}{30}$ of an inch. When mature, each has three coverings—(1) the tunica fibrosa—connective tissue with vessels; (2) the membrana propria—non-vascular connective; and (3) the membrana granulosa—rounded or columnar cells lining the cavity of the follicle and containing the liquor folliculi. The cells of the membrana granulosa are heaped up at one point to form a mass, termed the discus proligerus, in which lies the ovum. The **ovum** itself is a single large round cell, $\frac{1}{250}$ to $\frac{1}{200}$ of an inch in diameter when mature. It has a homogeneous cell wall—the **zona pellucida**; protoplasm—the **yelk**; a nucleus—the **germinal vesicle**; and a nucleolus—the **germinal spot**.

Development.—The ovary is formed from two tissue elements—(1) a differentiated portion of the membrane lining the abdominal cavity of the embryo; and (2) the connective tissue underlying it. Over a small area on the inner aspect of the Wolfian body the cells become columnar instead of being flattened as over the rest of the peritoneum. These columnar cells are the germinal epithelium, and form the ova and the investment of the ovary. The stroma of the ovary and the three coverings of each ovisac are formed from the subjacent connective tissue. By upgrowth of the connective tissue between the cells of the proliferating germ epithelium, groups of cells derived from the latter are surrounded by stroma, which then grows in between the germ cells of each group, separating them, and gradually surrounding each individual cell with connective. As each germ cell enlarges to form an ovum, the connective tissue corpuscles touching it form the membrana granulosa. Those outside this form

the membrana propria, and the layer outside this bearing the blood vessels forms the tunica fibrosa. Thus a complete Graafian follicle is formed round each cell derived from the germ epithelium. As each follicle enlarges it sinks deeper into the ovary, the younger and smaller ones occupying the peripheral zone just under the germ epithelium. The above is the view of Foulis concerning the development of the ovisac, and is the one now generally accepted; but earlier views must be noted.

Older Views.—Valentin and Pflüger described the in-

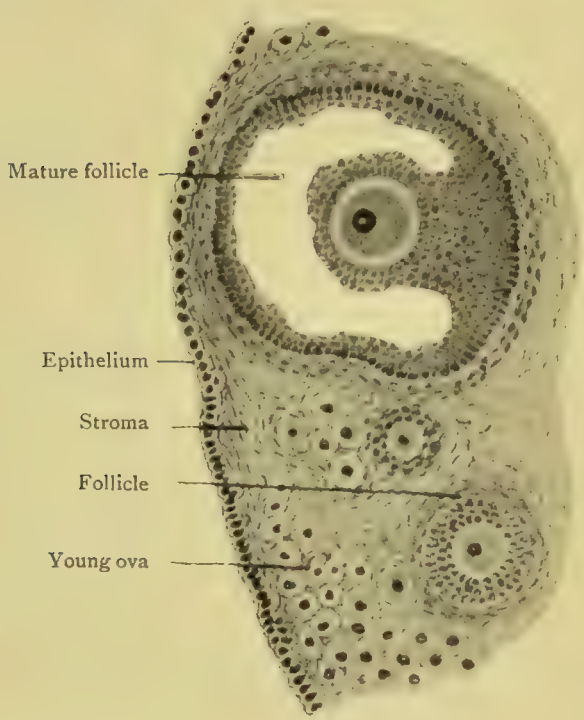


FIG. 4.—Section of ovary.

growth of tubules from the surface of the ovary, lined with epithelium on a basement membrane, large round cells occupying the lumen of each tube. These large cells formed the ova, the lining epithelium of the tubules forming the membrana granulosa. Waldeyer described the up-

growth of the stroma in branching columns engulfing solid rods of germ epithelium. These rods broke into segments, one cell of each segment forming the egg, the others forming the membrana granulosa. Kölliker, however, derived the membrana granulosa from certain cellular elements existing in the stroma, while Foulis traced its origin to the connective tissue corpuscles of the stroma itself. Thus the Graafian follicle is at first solid, the egg cell embedded in a mass of smaller rounded cells, which is enclosed in a layer of non-vascular connective, outside of this being a vascular investment. As the follicle enlarges, a split appears amongst the cells of the membrana granulosa. This split enlarges to form the cavity of the follicle, and becomes filled with the liquor folliculi, while the ovum assumes an eccentric position, remaining embedded in the cells of the discus proligerus.

CHAPTER II.

FUNCTIONS OF THE FEMALE REPRODUCTIVE ORGANS.

Reproductive Life.

In the last chapter certain structures are briefly described which do not function during the earlier and later years of life. In structure woman is female from birth till death, in function she is a reproductive organism from puberty till the menopause. The reproductive life of a woman is marked off from the rest of her existence by the fact that, whilst it lasts, she is constantly passing through a series of cyclical changes, interrupted normally only by pregnancy and lactation. The most obvious sign of this series of changes is a periodic disturbance marked by a discharge of blood from the mucous membrane of the uterus, mixed with cellular detritus and mucous from the whole genital tract, and occurring at approximately monthly intervals. But while menstruation is the most obvious process beginning at puberty, the most important is the ripening of ova and their escape from the ovary. Periodic sanguineous discharge occurs only in homo and in some of the higher apes, whereas ovulation is a process essential to sexual reproduction throughout the organic world. The periodic "rut" or "heat" of many animals—a time of pelvic congestion, mucous discharge, and sexual appetite—is closely related with the ripening of ova. The relation of menstruation to ovulation is less clear.

Puberty.

At puberty the whole body fills out and becomes more rounded in contour. The breasts develope and the hips widen considerably. Hair appears on the genitals. The body of the uterus enlarges to its full size, having previously been small relatively to the cervix. Ovulation and menstruation commence, and reproductive life is begun. Puberty, as marked by the onset of menstruation, most commonly arrives at the ages of 14, 15, or 16 years. Less frequent are the ages of 17 and 13, and in occasional cases menstruation begins as early as the tenth year and as late as the twenty-first. The appearance of menstruation outside these limits constitutes a serious departure from health. The age at which puberty occurs varies with several conditions. Climate has a marked influence, as in warm regions the majority first menstruate at 12 and 13 years, in temperate regions at 14 or 15 years, and in cold regions at 15 or 16 years. Race is also an important condition. For example, amongst Slavonians 16 and 17 years are the commonest ages, amongst Jews 14 and 15 being usual. The race habit is a more important factor than climatic influence, for Europeans, though born and brought up in India, begin to menstruate as late as in Europe. Social condition also has some weight, as the rich and luxurious arrive at puberty sooner than the poor and hard working classes. Early sexual stimulation is said to lead to precocious puberty.

Ovulation.

Escape of ovum.—The older and larger Graafian follicles sink, as they mature, deep into the ovary, leaving the smaller and younger ones near the surface. But as each period of ovulation approaches, one follicle further enlarges, so that its surface again nears the surface of the ovary. There is

a great increase of vascularity in the tunica fibrosa and the stroma surrounding it; the liquor folliculi becomes more abundant, and is rendered opaque by the presence in it of leucocytes and blood corpuscles. The follicle now forms an excrescence on the surface of the ovary, while the pressure of the fluid within it causes fatty degeneration and thinning of its wall. This finally breaks at the weakest point—the stigma—and the ovum escapes in a rush of liquor folliculi, some cells of the discus proligerus still adhering to it.

Transit to uterus.—The ovum now lies in the peritoneal cavity near the posterior surface of the broad ligament. The fimbriated end of the Fallopian tube may erect itself toward the ovary, and so receive the ovum almost directly into its ostium abdominale. More probably the motion of the cilia covering the fimbriae causes a current which sooner or later draws the ovum into the tube. A recent view is that this current sets along the fimbria ovarica in a groove formed between the broad ligament and the contiguous viscera. The analogy of the lower vertebrata, and of those cases in which an ovum from the ovary of one side has been proved to have passed into the tube of the other side, favours the view that ciliary action is the important factor in determining the course of the ovum. It is estimated that as long as nine or ten days may be spent by the ovum *en route* from the ovary to the cavity of the uterus.

Corpus luteum.—The escape of the ovum and liquor folliculi is preceded by proliferation of the membrana granulosa and the assumption by its cells of a yellow tint. After the rupture, the cavity of the ovisac fills with blood which forms a clot. Vessels and connective tissue now grow in amongst the yellow cells of the membrana granulosa and enclose them in a vascular framework. This so enlarges the membrana granulosa that it becomes convoluted and presses upon the blood clot, which becomes decolourised and organised, finally shrinking into a stellate white scar in the middle of the convolutions of vascular connective. If

pregnancy does not occur, this mass of tissue gains its maximum size, 12 × 13 mm., in the third week, when the clot is still reddish and the convoluted membrana granulosa pale yellow. In the fourth week the convoluted wall is brighter yellow, the clot being smaller and nearly decolour-

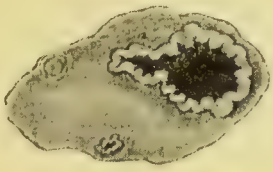


FIG. 5.—Section of Ovary, showing shrinking corpus luteum.

ised. At the end of two months an insignificant cicatrix is all that remains (Dalton). This structure is called the corpus luteum of menstruation. The corpus luteum of pregnancy has a different history, and will be described amongst changes due to pregnancy.

Maturation of ovum.—It must be remembered that, in all animals whose reproductive processes have been fully investigated, the egg "matures" before fertilisation can occur. The germinal spot (nucleolus) and germinal vesicle (nucleus) disappear, so that the egg becomes a mass of granular protoplasm. The nucleus then reappears, and going through karyomitosis, divides into two halves. One half of the nucleus with a little protoplasm is then pushed out from the cell. This process is known as extrusion of the first polar body. Next occurs the extrusion of the second polar body,—being an exact repetition of the former process, and the egg, having now lost apparently three-fourths of its nucleus and a little of its protoplasm, is ready for fertilisation. Certain invertebrates have eggs which can segment and form an embryo without fertilisation. These parthenogenetic eggs extrude only one polar body. As all other eggs appear to extrude two, it is probable that the human egg does so, its nucleus dividing twice before fertilisation.

Menstruation.

General phenomena. — With each appearance of the menses or katamenia, there may be some nervous and gastric disturbance, some feeling of weight in the viscera and some uneasiness in the breasts. Many women have very little conscious variation from their usual health. Others may have much pain, headache and general discomfort short of actual dysmenorrhoea. A monthly cycle can be traced in several functions. Thus the excretion of urea reaches a maximum before and a minimum after each period. The temperature rises about half a degree above the woman's average before the flow, falls during its continuance, and sinks about half a degree below her normal after it. The pulse and arterial tension follow a similar course.

Local phenomena. — Before and during menstruation there is unusual congestion of the pelvic viscera. The breasts also are turgid, as if the glands were about to commence secreting. The ovaries are injected and an ovisac is often seen ruptured or ripe to the point of bursting. The tubes and uterus are also turgid with blood, as are the vagina and vulva in a less degree; their mucous glands and surfaces all secrete freely. The endometrium in the body of the uterus is usually $\frac{1}{25}$ to $\frac{1}{20}$ inch thick, but before menstruation it grows rapidly in thickness and is thrown into folds. It is now as much as $\frac{1}{6}$ inch thick, and is the only source of sanguineous discharge.

Source of discharge.—Williams holds that the whole of the mucosa down to the muscular wall is shed at menstruation, being subsequently renewed by growth of the cells lining the ends of the crypts embedded in the muscle. He considers most of the muscular wall of the uterus to be a muscularis mucosae. The cases in which he examined the endometrium P.M. after menstruation seem to have died of acute febrile processes which might themselves have destroyed the mucosa. Pouchet, Tyler Smith, Kundrat,

and Engelmann agree that a superficial portion only of the mucosa is shed, the causes of its separation being pressure in the subjacent capillaries and fatty degeneration of cells near the surface. Leopold and Wyder agree as to the superficial shedding of mucosa; but do not put forward fatty degeneration as its cause. Möricke, after curetting uteri during menstruation, affirms that no part of the mucous membrane is shed. The weight of authority thus gives reason to believe that there is a loss of epithelium, at least over more or less of the surface of the uterine cavity. In many cases very slightly if at all pathological, shreds of uterine mucosa are constantly found amongst the discharge; and, in cases of so-called membranous dysmenorrhœa, complete casts of the cavity of the body are often obtained, consisting of epithelium and subjacent connective, and containing the crypts and their openings.

Stages and composition of discharge.—The normal function may be divided into three stages. First, the **invasion**, lasting three or four hours, and marked by pelvic congestion and the discharge of mucous, faintly tinged with blood, and having an odour *sui generis*. Epithelial cells, mostly from the cervix and body of the uterus, a few blood corpuscles, and mucous corpuscles are to be found. Second, the **persistence**, lasting one or two days, with bright red discharge consisting of a quantity of blood mixed with the mucous and cellular detritus. Thirdly, the **decline**, lasting two or three days more, with less red blood; so that the discharge is paler in colour, but is turbid from the large number of degenerating cells of varied origin. Towards the end of the flow the discharge becomes clear, and consists mainly of mucous. When a moderate amount of blood passes from the uterus it becomes mixed with the acid secretion of the vagina, which prevents it from clotting. When clots are passed the blood has either remained in the uterus long enough to allow of coagulation, or it has escaped into the

vagina in too great quantity to be kept liquid by the acid mucous present at the time.

Habit.—The quantity and duration of the katamenia usually vary directly with one another, and are both included in the term menstrual habit. The quantity is difficult to estimate, but a usual amount is said to be five to seven ounces. Less than two or more than seven ounces may be considered pathological. Variable for a few months at puberty, the quantity should be nearly the same every month after the establishment of the function. The duration of the flow also varies at first; but thereafter it lasts within a few hours of the same time at each recurrence. Three and four days are the commonest durations; and five, six, and seven days are by no means rare. Less than two days, or more than eight days duration, however, shows a distinct deviation from health.

Type.—In from 80 to 87 per cent. of women, menstruation occurs at regular intervals after it is once established; in the remainder it is irregular, that is, the patient can never tell on what day she will next be unwell. The periodicity or frequency of recurrence is called the menstrual type. The type is determined by the number of days from the beginning of one period to the beginning of the next; in other words, it is the length of the cycle of changes in pulse, temperature, and excretion of urea referred to above. By far the commonest type is the 28 days —as 71 per cent. of women who are regular begin to menstruate on the same day of the week every four weeks. 14 per cent. are of the 30 days' type; 2 per cent. are said to be of the 21 days' type, and 1 per cent. of the 27 days' type. These percentages are doubtless almost classical, but in practice women of 26 and 27 days types are frequently met with.

Interruptions.—Pregnancy and lactation are the only physiological periods of amenorrhoea occurring during reproductive life. The menses, however, may appear once or

twice in lessened degree during the first two months of pregnancy. This is accounted for by the fact that up to the end of the second month the decidua reflexa has not completely blended with the decidua vera, so that there remains a uterine cavity lined with mucosa, from which discharge may occur. The few instances of discharge persisting throughout pregnancy are pathological. Menstruation will recur during lactation if this is prolonged beyond the normal limit, and often does so before it. When lactation is checked prematurely the menses soon appear. Pregnancy may, of course, occur during the amenorrhoea of lactation.

Terms.—Amenorrhoea = too little discharge or none at all.
Menorrhagia = too much discharge.
Metrorrhagia = discharge of blood apart from menstruation.
Leucorrhoea = yellow or other discharges—not blood. "Whites."

Menopause.

Age.—The menopause, climacteric, or change of life arrives normally between the ages of 35 and 55 years. In 75 per cent. it is between 40 and 50. For in 50 per cent. it is between 45 and 50, and in 25 per cent. between 40 and 45. In 12 per cent. it is between 50 and 55; and in 12 per cent. between 35 and 40. Menstruation occasionally ceases at the age of 21, and has been known to persist as late as 65 years. As a general rule, when menstruation begins late it will end early; and, *vice versa*, early puberty will indicate a late menopause. The natives of hot climates, however, have a short reproductive life, puberty and the menopause alike occurring very early. Numerous pregnancies tend to prolong reproductive life by postponing the menopause.

General phenomena.—There is often great disturbance of

health at the climacteric, the nervous system being specially liable to derangement. Menstruation may stop suddenly, or may gradually and regularly disappear. There may be great irregularity, and sometimes considerable temporary increase of discharge. With the cessation of menstruation and ovulation general changes occur no less marked than those associated with their onset. There are two main lines of change. Some women tend to general adiposity; some become thin, angular, and muscular. Hair may grow on the face, and a masculine appearance be assumed.

Local phenomena. — There are also important local changes. The gland tissue of the mammae suffers atrophy, being replaced by fat in those women who tend to adiposity. There is general atrophy of the genital organs. The ovaries are small and contracted by cicatricial tissue. The tubes may have their lumina obliterated. The uterus withers, its muscle being replaced by fibrous tissue, its walls are thinned, and the cervical canal may be obliterated in the shrinking of its cavity. Fibroid tumours of the uterus are well known to shrink at this time, and often practically disappear. The cervix uteri retires; the walls of the vagina become contracted, especially at the roof, so that the exploring finger passes up a canal rapidly narrowing toward the top, where a mere dimple may represent the once prominent cervix. The tissues of the pelvic floor lose their strength and elasticity, so that cystocele and rectocele may occur. The mons veneris and labia majora lose their fat and shrink, the latter allowing the labia minora to project between them, and so to become dry and leathery. It is a remarkable fact that in women living after the menopause in the connubial state these changes in the vagina and external genitals hardly can be said to occur, as in them the vagina remains capacious, and the tissues of the pelvic floor retain their tone.

Fertilisation.

For information as to the actual union of sexual elements we depend on analogy from the lower animals. A single spermatozoon penetrates the zona pellucida and becomes motionless; its head becomes fused with the nucleus of the ovum, and its tail disappears. In mammalia no micropyle or opening in the zona pellucida has been seen, it is therefore probable that the spermatazoon can penetrate the egg cell-wall at any point. It is well known that in many mammals fertilisation occurs in the Fallopian tubes. In homo it is probable that it can occur both in the tubes and in the uterine cavity. Tait, Wyder and others assert that the cavity of the uterus is the only locality in which fertilisation normally occurs. They maintain that the action of the cilia lining the Fallopian tubes carries the ovum down, and also prevents spermatozoa from going up. The frequency of tubal pregnancy is cited to disprove this theory; but, in answer, it is stated that tubal pregnancy can only occur when some pathological process has so impaired ciliary action as to allow the ascent of spermatozoa into the tube. It is estimated that spermatozoa can travel one inch in seven and a half minutes by their own activity; and as, in a suitable situation, these organisms can live for several days, it would follow that they are quite capable of traversing the vaginal and uterine cavities unaided. The frequency with which pregnancy occurs in spite of the presence of an unruptured hymen with a very small aperture gives proof that this is possible. It is thought that by certain contractions during coitus the uterus may actively suck up seminal fluid from the vagina; but this hypothesis is unnecessary except to explain the occurrence of pregnancy in spite of preventive douching of the vagina just after coitus. It may also explain the supposed greater frequency of conception after coitus accompanied by sexual orgasm in the female. These considerations are of but slight importance,

as many women conceive frequently who have never experienced the sexual orgasm.

Conception.

At every part of the menstrual cycle coitus may be followed by pregnancy. For spermatozoa deposited in the vagina several days before or after ovulation may impregnate the ovum; and furthermore, ovulation may occur at any time. The statistics of pregnancy after a single coitus are given by Ahlfeld as follows:—First week after menstruation, 37 per cent.; second week, 35 per cent.; third week, 15 per cent.; fourth week, 9.7 per cent.; 29th to 31st days, 2.7 per cent. In 72 per cent. of all the cases, or in 88 per cent. of those where menstruation was regular, pregnancy followed coitus during the first fortnight. Thus it may be stated that conception occurs usually within two weeks after a menstrual period; much less frequently during the days just before a period; and, occasionally, quite remote from menstruation, as during lactation and other times of amenorrhoea.

Nubility.

Though reproductive life begins at about the age of fourteen years, this is by no means the proper marriageable age. It must be determined at what age women can undertake pregnancy and labour with least risk to themselves on the one hand, and with the greatest prospect of bearing healthy children on the other; for the individual and the race both demand consideration. The figures of Bertillon show that marriage before the age of twenty involves grave risks of death to the mother. The children of immature parents are often weak and ill-developed; they are specially liable to the attacks of many forms of disease, and very frequently die before reaching adult life. There are usually fewer children of early marriages than of those contracted after maturity. After the age of twenty-five the

risks to the mother attending a first labour gradually increase, and conception becomes less likely to occur. The children of senile parents are of low vitality and poor in powers of resisting disease. They often look older than their age, and indeed may be said to be born physiologically old, and tend to degenerative diseases as long as they live; just as the children of the immature resemble physiologically those whose birth is premature. A woman who marries between the ages of twenty and twenty-five has the smallest risk of sterility and of excessive family, of difficult or fatal labours, of abortion, of plural pregnancy, and of bearing imperfect and unhealthy children.[1]

Theories on Menstruation, Ovulation, and Conception.

Old Views.—Many theories have been propounded concerning menstruation. It was long thought to be a periodic cleansing, ridding the body of noxious accumulations. It has been looked upon as a disease due to civilisation, and has been considered, like hernia, to be one of the prices we pay for the advantages of the erect posture. The old theory that menstruation affords an outlet for plethoric accumulations has been revived in the light of a recent study of the evolution of sex by Geddes and Thomson.

Geddes and Thomson.[2]—Their postulate is that during the reproductive life of a female organism her anabolic changes preponderate over the katabolic: thus woman after puberty manufactures from her food more protoplasm than is needed to supply the waste of her own organism. This surplus is disposed of, failing pregnancy, in the monthly losses, instead of going towards the production of an individual of the next generation. If conception occurs, the surplus goes to nourish the foetus which is an endoparasite on the mother during utero-gestation. During

[1] A. R. Simpson, Brit. Gyn. Journ., Aug. 1892.

[2] Evolution of Sex. Walter Scott, 1889.

lactation the production of milk removes the surplus result of the anabolic processes of the mother, the child being an ectoparasite on her. After lactation is over, menstruation will again remove the surplus till the next pregnancy, and so on till the end of reproductive life.

Ovulation Theory.—In recent years the ovulation theory has been generally accepted. This view assumes that one or more Graafian follicles come to maturity and rupture at regular intervals, and explains menstruation as consequent upon the pelvic congestion accompanying this process. Thus Mathews Duncan used to compare menstruation to a red flag raised at the door of an auction mart to show that something was going on inside. It was noted that women castrated before puberty do not menstruate, and that the same holds true of those in whom the ovaries are congenitally absent. The fact that an artificial menopause can usually be caused by removing the ovaries also gave weight to this view that ovulation causes menstruation and determines the time of its occurrence.

Period of Ovulation.—This being generally accepted, writers went on to discuss the exact period of ovulation, and attempted to determine whether it occurred before, after, or during the menstrual flow. The calculation of the probable duration of pregnancy from the last menstruation practically assumes that that ovum is fertilised which, by the ovulation theory, corresponds to the last menstrual period which occurs. The opposite view—namely, that the fertilised ovum corresponds to the first menstrual period missed—is supported in a graceful theory by Loewenhardt. He points out that along with the maturation of an ovisac the endometrium thickens, and suggests that this thickening is the beginning of the formation of a decidua which will receive the egg if it be fertilised. This decidua is shed with the placenta and membranes if utero gestation proceeds to full term. If premature labour or abortion occurs, the decidua is shed with the ovum. If tubal preg-

nancy occurs and the ovum perishes, the decidua comes away often in the form of a cast of the uterine cavity; and similarly, if the ovum fails to be fertilised, the decidua corresponding to it is shed in the exfoliation of endometrium at the next menstrual period. Thus there would be no menstruation corresponding to an ovulation whose ovum became fertilised. This theory suggests the name **decidua menstrua** for the portion of endometrium shed at menstruation and corresponding to an unfertilised ovum. But these theories have now only a historic interest, and the idea that ovulation determines menstruation is a thing of the past.

Facts against ovulation theory.—There can be no pregnancy without ovulation, but pregnancy frequently occurs without menstruation. Girls who have never menstruated have become pregnant, so also have women who have ceased to menstruate. Pregnancy occurs during the physiological amenorrhoea of lactation, and during the pathological amenorrhoea of many morbid conditions. Therefore ovulation goes on without menstruation. Further, menstruation can occur without ovulation, for it often continues after both ovaries have been removed. Abdominal section is now a common operation, and has been done at all parts of the menstrual cycle. Follicles have been seen just ruptured or on the point of rupture at all times before, after, and between menstrual periods, and in cases of operation just before and just after a period it has been noted that no follicle was ripe. It may be said that the subjects of operative interference are pathological and do not afford valid evidence; but many sections are done for the relief of conditions involving no disease of the reproductive organs, and the same results are obtained from P.M. examination of women who have died suddenly or perished by accident at various parts of the menstrual cycle. It is also remarkable that Heape, who examined forty monkeys during menstruation, found ovulation going on in only two of them.

The facts then are, that women ovulate frequently, and menstruate, many of them, regularly. The functions are independent of one another. Ovulation does not cause menstruation, and need not occur near or during the process.

The nervous mechanism.—When it was noted that menstruation often continues after the removal of both ovaries, the view was advanced that the tubes as well as the ovaries must be removed to ensure the stoppage of menstruation. But this is not always effective, and it is probable that when Battey's operation and Tait's operation do cause menstruation to cease, it is not by removal of ovaries or tubes, but by cutting a certain nerve or nerves in the broad ligament. This naturally leads up to the view that menstruation is under nervous control. Christopher Martin has elaborated this view, and states that menstruation is presided over by a special nerve centre situated in the lumbar part of the cord; and that impulses to menstruation reach the uterus through the pelvic splanchnics or the ovarian plexus, or both.

Menstruation and Conception.—Hart points out that, in non-menstruating animals, the epithelial cells covering the chorionic villi have a phagocytic action, eating up the epithelium of the uterine mucosa, so as to come into contact with the subjacent connective tissue. Thus the ovum is engrafted upon connective tissue. In the human subject connective tissue is laid bare in the cavity of the body of the uterus by the shedding of the superficial endometrium at menstruation. Thus the human ovum is able to graft itself after menstruation in the place where gestation can safely proceed. Pflüger first suggested that the human ovum can only be implanted on connective tissue, and thus cannot develope in the healthy tube or the cervix, and the view has been strongly upheld by Lawson Tait. It accounts for the frequency of conception just after menstruation, and for the fact that tubal pregnancy is usually preceded by disease destructive of the tubal epi-

thelium. But this hypothesis does not account for those cases of tubal gestation with no previous tubal disease, nor for the occurrence of utero gestation remote from menstruation, as during lactation and pathological amenorrhoea. There is no reason, however, for supposing that human villi have entirely lost the power of eating their way through epithelium like those of other mammals; and all the facts are explained by allowing that they occasionally exert their phagocytic action on the mucosa of a healthy tube, or on an endometrium which has not, for months before, been denuded by menstruation.

Evolution of menstruation.—The evolution of the conditions just described might be explained by natural selection. For suppose a community of non-menstruating primates to produce certain females who vary from the rest of their species and menstruate. These aberrant females will easily conceive in utero, and accordingly will be more fertile than average members of the species, while their progeny will also tend to menstruate. The variation, in fact, will be a favourable one, tending to prevent the occurrence of pregnancy in unsuitable places, *e.g.*, tubes, and at unsuitable times, *e.g.*, during lactation. Accepting the views of Geddes and Thomson, the variation is also explicable, as it would be the most essentially female of the females of the species—on their view those with the greatest preponderance of anabolic over katabolic processes—who would first have a surplus of highly elaborated material to be disposed of in menstruation. Doubtless no modern biologist would deny that the function began as a variation, was transmitted to offspring, and, being advantageous, became by natural selection characteristic of homo and a few other primates. For were menstruation of no advantage to the race, it would have been eliminated by natural selection. In seeing the nature of the variation, and how it is of advantage, a slight advance is made in our comprehension of the subject.

CHAPTER III.

PREGNANCY.

CHANGES IN THE MOTHER.

Changes in the Uterus.

Form of body. — From the beginning of pregnancy onwards, the uterus undergoes certain changes of shape, as well as growing in volume. The body loses its pyriform shape and becomes more and more rounded till the end of the third month. It then grows most rapidly above, the fundus rising and becoming narrower, while near the cervix greater breadth is retained until the fifth month. After this the pyriform shape is regained, as the fundus broadens out rapidly, and the uterus remains wide and rounded above, but narrower below until full time.

Cervix.—The cervix becomes softened and its vascularity is increased during pregnancy. This may be noticeable after the first month, it becomes characteristic at the fourth month, and from this time onwards it is a marked feature of pregnancy. The Cervix appears shortened to the exploring finger from the fifth month onwards ; but no real shortening occurs, as the cervix grows during pregnancy like the rest of the uterus. As the uterine walls thicken and widen out, however, the cervix presents to the finger a portion of a larger curve than usual ; also the vaginal walls become less firmly attached round the cervix, and this is drawn upward as the growing uterus rises into the abdominal cavity. These two considerations account for the apparent shortening of the cervix. The cervical canal is not opened up until just before labour in multiparae and

until labour actually begins in primiparae; for though the tip of a finger may often be passed into the cervical canal of a multiparous woman during the later weeks of pregnancy, the os internum can be felt as the narrowest part of the passages until labour is about to begin. During pregnancy the cervical canal is normally occluded by a plug of mucous.

Position.—At the beginning of pregnancy there is a slight increase of the normal anteversion of the uterus, and the organ sinks slightly downwards in the pelvis. These changes are due to its increased weight, and may cause slight symptoms through pressure on the bladder and rectum, which are soon relieved as the growing uterus rises in the pelvis to become an abdominal organ. The non-gravid uterus often lies a little to the right of the middle line of the body, and a similar deviation occurs in pregnancy in 76 per cent. In 20 per cent. the uterus is found in the middle line, while in 4 per cent. it is said to deviate to the left. In explanation of this is mentioned the position of the rectum in the left side of the pelvis, also the fact that most people sleep on the right side. The round ligament of the uterus is stated to be shorter on the right than on the left side.

The uterus is also rotated on its long axis, its left border coming forward so much that the transverse diameter of the uterus may coincide with the oblique diameter of the bony pelvis.

Size.—The non-gravid uterus is 3 in. long, 2 in. broad at its widest part, and 1 in. deep. Farre and Tanner give its dimensions during pregnancy as below:—

	Length.	Width.	Depth.
End of 3rd month,	4½ to 5 in.	4 in.	3 in.
,, 4th ,,	5½ ,, 6 ,,	5 ,,	4 ,,
,, 5th ,,	6 ,, 7 ,,	5½ ,,	5 ,,
,, 6th ,,	8 ,, 9 ,,	6½ ,,	6 ,,
,, 7th ,,	10 ,, 11 ,,	7½ ,,	6½ ,,
,, 8th ,,	11 ,, 12 ,,	8 ,,	7 ,,
,, 9th ,,	12 ,, 14 ,,	9½ ,,	8-9,,

The uterus comes into contact with the abdominal wall during the fourth month, when it may be considered an abdominal organ. About the middle of the fifth month the fundus reaches the umbilicus, and by the seventh month it is midway between the umbilicus and the ensiform. Early in the ninth month it is close to the edge of the ribs, but the whole uterus sinks slightly during the last two weeks of pregnancy.

Volume.—As the walls of the non-gravid uterus are in contact the volume of its cavity is practically nothing, while the cubic content of the full time uterine cavity is over 500 cubic inches.

Weight. — The nulliparous uterus weighs about one ounce, the parous but non-gravid uterus weighs about one and a half ounces, but at full time the organ weighs from twenty-four to twenty-eight ounces.

Peritoneum. — The peritoneal covering of the uterus grows like the other layers of its wall, but becomes stretched and scarred. During involution it becomes crumpled and thrown into folds.[1]

Muscular wall. — During the first three months the uterus enlarges, mainly through growth, and its muscular wall thickens. Later, in addition to its own growth, the uterus is distended by the growing ovum, and its wall tends to become thinner. At the end of pregnancy the general thickness of the wall is half an inch, but near the cervix it may be as small as a quarter of an inch.

This enormous increase in area, without diminution in thickness of the muscular wall, is due to the active growth of all its elements. The individual muscle fibres grow to from 50 to 80 times their original length, and increase 2 to 3 times in thickness. In addition to this growth of existing fibres, new ones are formed from embryonic cells of irregular outline which are seen in sections of the non-gravid uterine tissue. A fully developed fibre may be as much as $\frac{1}{50}$ in.

[1] See sectional anatomy of labour.

in length. The outer layer of muscle fibres is thin, and consists of longitudinal and transverse bands covering the uterus before and behind, and passing off it into the various ligaments. The middle layer is thick, and its fibres are arranged very irregularly. They form networks round the arteries and sinuses, the latter having no muscular walls of their own. The inner layer is thinner, and its fibres run in a circular manner round the uterus and form concentric bands round the orifices of the two Fallopian tubes and the os uteri. Round the os internum the concentric fibres form a specially strong band.

Arteries.—The arteries of the uterus become during pregnancy more tortuous than ever. This demands active growth on their part, and there is a marked thickening of their walls, which persists after the end of gestation.

Veins.—The veins also grow largely. They have no valves and their walls are very thin; but they run parallel to the surface, and have sudden bends and angles at which their course is closed during uterine contractions. Large sinuses are formed especially in the inner portion of the uterine wall, and in the region of the placenta. These are supported only by the muscle fibres of the inner layer, as they have no muscular wall of their own.

Lymphatics.—The lymphatics grow with the other elements of the uterine wall, their absorbent action being of paramount importance during involution. The ease and rapidity with which septic matter is absorbed from the endometrium during the puerperium depends upon and is explained by the exaggeration during pregnancy of the lymphatic elements of the uterine tissue.

Nerves.—There is actual growth of the nerve fibres and also of the cervical ganglia in preparation for the nervous mechanism of parturition. It is noticeable that the irritability of the uterine nerves is much heightened during pregnancy, as shown by the ease with which contractions are induced.

Decidua.

Mucosa.—While the endometrium is about $\frac{1}{20}$ in. thick after and $\frac{1}{6}$ in. thick before menstruation, it increases rapidly during early pregnancy, and reaches its maximum thickness of $\frac{1}{3}$ in. at the third month. The so-called glands enlarge and their cavities dilate. Numerous thin-walled vessels increase the vascularity of the tissue. The connective tissue cells with large nuclei of oblong or polygonal shape proliferate and increase in size up to $\frac{1}{500}$ in., becoming the so-called "decidual" cells characteristic of the mucosa of pregnancy. They are most numerous near the free surface of the mucosa which is covered with columnar epithelium, many of whose cells, however, are flattened so as to resemble endothelial cells both on the surface and in the necks of the glands. The mucosa consists of three layers.

Compact layer.—1. A superficial compact layer with many decidual cells lying between the glands, which are not much dilated, but whose epithelium is flattened and degenerated. **Spongy layer.**—2. A spongy or reticulated layer whose glands are very widely dilated, with spindle cells and fibrils of connective tissue between them. **Deep layer.**—3. A thin dense layer consisting of connective tissue containing the blind ends of the glands whose epithelium is unchanged. This layer lies closely attached to the muscular wall. Separation of the decidua at abortion or full-time parturition occurs through the spongy layer of the mucosa, the dilated glands acting like the row of perforations between two postage stamps, and allowing separation to occur easily through this layer. After the separation of the decidua the mucosa is renewed, and covered by the epithelium of the blind ends of the glands which remain attached to the muscular wall.

Ovum and Decidua.—If we examine a pregnant uterus at any time before the end of the second month, we find a uterine cavity still existing, lined by decidual mucosa. The

ovum lies embedded in the compact layer of the decidua on one wall of the cavity. The whole surface of the ovum is in contact with the decidual connective tissue, none of the epithelium of the maternal mucosa touching it at any point. The ovum can only reach this position, embedded in decidua, in one of three ways. First, the ovum may settle on the surface of the mucosa which then grows up in folds round it, the folds uniting above to enclose it. In this case the maternal epithelium touching the ovum must be destroyed by contact with the ovum. Second, the ovum may destroy the maternal epithelium on which it settles, and so may eat its way into the decidua, which by growth renews itself over the ovum. Third, the ovum may settle on a portion of the uterine mucosa which has been denuded of its epithelium in menstruation. As the mucosa is renewed, it simply grows over the ovum and encloses it, as a granulating surface will grow over and cover a pea placed upon it. The first possibility is an old and largely rejected theory of the origin of the deciduae. The second way is that which occurs in most mammals; and, according to the views on the relation of menstruation to conception expressed in Chapter II., the third way is that which usually occurs in the genus homo.

Serotina, Vera and Reflexa.—Whichever view is taken, the decidual tissue is described in three portions relative to the ovum. The decidua underlying the ovum, *i.e.* between the ovum and the uterine wall, is called the decidua serotina. That between the ovum and the uterine cavity, *i.e.* covering the ovum, is called the decidua reflexa. The rest of the decidua, lining the rest of the uterine cavity and not touching the ovum, is called the decidua vera.

The origin of these names lies in John Hunter's misconception that there was a closed sac of false membrane lining the uterine cavity. When an ovum descended from one Fallopian tube it was thought to push in one corner of this sac to form the decidua reflexa, the rest of the sac being

the decidua vera, and a newly formed membrane under the ovum being the decidua serotina (*serus*, late). The decidua was described correctly by William Hunter as the developed uterine mucosa, but the wrong idea of a false membrane of coagulable lymph was long current, and the nomenclature derived from it remains in use.

Serotina.—The decidua serotina ultimately takes part in the formation of the placenta. It is about half the thickness of the vera. Its compact layer is twice as thick as its spongy layer, and has no epithelium, except a little, flattened and degenerated, in the small traces of glands which it possesses.[1] Hart and Gulland found, as early as the sixth week, proliferation of the endothelium of degenerated veins. Webster[2] found the endothelium of vessels proliferating and invading the surrounding tissue in the early weeks of tubal pregnancy. This was previously thought to occur only after the eighth month. The decidual cells near the growing placenta are altered and degenerated. Deeper in the serotina they are like those of the vera, and can be seen to develope from the connective tissue corpuscles.

Vera.—The decidua vera is from $\frac{1}{4}-\frac{1}{3}$ in. thick, its spongy layer being almost twice as thick as its compact layer. Its surface is covered with columnar epithelium, usually somewhat degenerated. The compact layer contains numerous large decidual cells, with darkly staining nuclei, and a few leucocytes. These elements lie between thin-walled blood vessels and the necks of the uterine glands. The spongy layer has very large spaces, the dilated glands, lined by flattened and altered epithelium. There are fewer decidual cells in the inter-glandular tissue. The dense layer next the muscular wall contains the undilated blind ends of uterine glands, lined by unaltered epithelium.

Reflexa.—The reflexa, where it joins the vera and the

[1] Selected Papers, Hart, 1893, p. 53.
[2] Ectopic Pregnancy, Webster, 1895, p. 127.

serotina, has the same thickness and structure as the compact layer of the vera. The glands and vessels of the vera can be traced into the reflexa, and the epithelium of the vera is continuous with that covering the reflexa. The reflexa, however, becomes thinner and different in structure as it leaves the vera, and covers the unattached pole of the ovum. The epithelial covering is lost, and there are no glands. There are few decidual cells, and these are degenerated, the tissue of the mucosa being replaced by coagulated fibrin, containing numerous degenerated leucocytes.

Fate of the Decidua.—At the third month the ovum, covered by the reflexa, begins to occupy the whole space within the uterus. The reflexa and vera now come into close contact, obliterating the uterine cavity, the epithelium covering them is lost, the two become adherent, and then fuse into a single membrane. Thus menstruation can occur only during the first two months of pregnancy, while there is still a cavity lined by uterine mucosa. This cavity obliterated, further bleeding can only occur by separation of the decidua from a portion of the uterine wall.

After the third month the decidua becomes less vascular, and consequently paler in colour; it is flattened out by the pressure of the growing ovum, and becomes thinner accordingly. Fatty degeneration or coagulation necrosis occurs in the decidual cells. The vessels become thrombosed by the proliferation of their endothelium, and before full time is reached, the decidua is reduced to a thin and very unimportant layer of maternal tissue, covering the ovum, and coming away with it by separating through the spongy layer from the remaining maternal mucosa.

Changes in other Organs.

Vagina.—During pregnancy the mucous membrane of the vagina becomes turgid and relaxed, so that it hangs in transverse folds. The muscular wall is hypertrophied and

relaxed. The urethral orifice is prominent, and all the structures of the vulva are swollen and enlarged. Varicose veins commonly develope on the labia, and at the vaginal orifice. The increased vascularity of the parts gives them a dark purplish colour, which is characteristic of pregnancy after the first few weeks, and is known as the "port wine colour" of Jacquemier.

Tubes and ligaments. — The Fallopian tubes enlarge and lengthen during pregnancy, as do the broad ligaments. They are altered in position as their point of attachment to the uterus rises; but through the growth of the fundus, their insertion at full time is at the junction of the middle and upper thirds of the uterus. They make a considerable angle with the brim, however, as the ovary remains near the brim. The round and all the uterine ligaments also lengthen, and grow in thickness.

Ovary.—Ovulation is arrested during pregnancy. The corpus luteum of pregnancy has a different history from that of menstruation, for, owing to the hyperaemia of the pelvic organs caused by pregnancy, it goes on growing till the end of the third month, when it is two-thirds of an inch in diameter. It is still present at the time of delivery, being then half an inch across. The scar remains for six or eight weeks after parturition. The yellow colour is marked. The convolutions of the membrana granulosa are firm, and blended into a tough wall, the original foldings being formed into septa. In about a third of those examined the cavity contains clear fluid: in the rest it is occupied by shrinking blood clot, as in the corpus of menstruation. (See page 18.)

Connective Tissue and Joints.—The pelvic connective tissue grows and relaxes like that of the ligaments of the uterus. There is also an increase of fat. The pelvic floor becomes softened and depressed *en masse*. There is some alteration in the joints, as the synovial membranes existing in the pubic symphysis and in the sacro-iliac synchondroses

enlarge and contain an increased amount of synovial fluid. The cartilages soften and swell, causing some separation of the bones concerned. These changes allow a certain amount of movement to occur at these joints, but not in the marked degree seen in many of the lower animals.

Mammae.—From the beginning of pregnancy onwards, changes occur in the mammae, slight tenderness and fulness like that connected with menstruation in many women being first noted. By the second month there is some enlargement due to the growth of gland tissue, the superficial veins become visible, and the nipples enlarged, prominent, and easily erected. The areola enlarges and becomes darkened by the deposition of pigment, certain enlarged glandular tubercles showing white against the darkened area round them. By the third month drops of clear secretion can be expressed, and as pregnancy advances this secretion becomes white, due to the appearance in it of cholostrum corpuscles. At the fifth month, the secondary areola appears, being an extension of the pigmentation of the skin around the now dark primary areola. This secondary areola is only noticed in women of dark complexion, in whom the pigmentation of the primary areola and the development of the tubercles of Montgomery are also much more marked than in fair women.

Mechanical Effects of Pregnancy.

Bladder and Rectum.—By the sinking of the enlarged uterus during the early weeks of pregnancy, frequency of micturition is often caused. The pressure of the uterus also causes some disturbance of the functions of the rectum, constipation being of frequent occurrence. Later the uterine tumour often impedes the venous return from the pelvis and lower limbs. Results of this are a tendency to varicosity in the veins of the legs and pudenda, and the formation or the enlargement of pre-existing piles. Oedema of the feet and legs is often seen.

Striae gravidarum.—The umbilicus is flattened out during pregnancy, and becomes prominent and everted at the eighth month. The distension of the skin causes the well-known striae gravidarum. They are most numerous over the lower part of the abdomen, and round the umbilicus, but they are frequently seen on the thighs and buttocks. They are also formed on the breasts as these enlarge and become distended. They may be caused by anything which stretches the skin, and are often seen in abdominal distension by tumours. Even the growth of fat may produce them. The striae are spindle-shaped, and vary from $\frac{1}{4}$ in. to 1 in. in length. In general they are arranged with their long axis curving round the umbilicus. When fresh the striae are smooth and purple in colour. Later, when the tension is removed, they become pearly white. They are produced by stretching, tearing and atrophy of certain portions of connective tissue of the cutis vera. The pearly-white colour they finally assume is that of scar tissue, as it condenses and contracts, obliterating the blood vessels which give the purplish tint in the early stages. These cutaneous striae occur during the last three months in 94 per cent. of pregnant women.

Separation of Recti.—In women of low muscular tone, the pressure of the pregnant uterus often separates the recti muscles in the middle line. This separation often persists, and may become very marked after a series of pregnancies.

Respiration and Digestion.—Towards the end of pregnancy the growing uterus interferes with the movements of the diaphragm, and so impairs respiration. At the same time it may cause some disturbance of digestion by pressing on the stomach, and hindering the peristaltic action of the intestines. These functions usually improve when the uterus sinks during the last two weeks of pregnancy, so reducing the increased intra-abdominal pressure.

Pelvic Inclination.—As the pregnant uterus gains in

weight, it has an appreciable effect upon the position of the centre of gravity of the erect female. Were her usual posture maintained, the weight of the uterus would bring the centre of gravity in front of the line joining the acetabula. But to maintain the erect posture with ease, the centre of gravity of the body must be behind this line. Therefore the woman throws back her body more and more as pregnancy advances, and so keeps the centre of gravity in its usual position. Tall women throw back the shoulders more than the lower part of the body; while short women throw back the whole trunk. This adjustment of the balance of the body must depress the sacrum relatively to the pubic symphysis, so that it may be stated that the angle between the horizontal and the conjugate gets less and less as pregnancy advances.

General Effects of Pregnancy.

Heart and Circulation.—The extra strain on the circulatory system during pregnancy causes physiological enlargement and hypertrophy of the heart, more especially of the left ventricle. The pulse rate is quickened, and is said to be less affected by posture than usual. The arterial pressure is increased.

Blood.—The quantity of blood in circulation is increased during pregnancy, and there are changes in its composition. Thus it is richer in fibrin and contains more leucocytes than usual, being accordingly poorer in red corpuscles and in albumen. The thyroid gland and the spleen are said to be somewhat enlarged.

Respiration.—During pregnancy the elimination of carbonic dioxide is increased, it is said, to the extent of 25 per cent. The chest becomes wider and shorter, and the breathing is markedly thoracic in character.

Urine.—There is an increase in the quantity of urine during pregnancy, due to the heightened blood pressure.

This must not be confused with the increased frequency of micturition common in the early months. The deposit called kyestime is not peculiar to pregnancy, and there is no great increase of the solid constituents.

Nervous System.—The nervous irritability is frequently increased during pregnancy, and usually becomes manifest in nervous reflex disturbances. The nausea and vomiting of the early months, known as "morning sickness," is the most obvious of these. Abnormal cravings and longings are often described, neuralgic attacks occur, and carious teeth are sure to ache. The temper is often uncertain, and the patient is frequently mentally different from her usual self.

Pigmentation.—Besides the deposit of pigment round the nipples, already described, there is a tendency to a deepening of pigmentation in the axillae, on the abdomen and pubes. Pigmented patches sometimes appear on the face; but the most characteristic of these phenomena is the appearance of the so-called **linea nigra.** This is a line of pigmentation extending in the middle line of the body from the pubes to the umbilicus, and frequently to the ensiform cartilage.

DIAGNOSIS OF PREGNANCY.

Many of the characteristics of pregnancy just described are not of use in determining whether or not a woman is pregnant. We therefore now re-state briefly those available for this purpose in the order in which they should be looked for clinically.

Rational or Indirect Symptoms of Pregnancy.

1. **Minor Symptoms.**—Apart from the patches of pigmented skin which are occasionally seen, a woman's face often gives, especially to one who knows it, indications of pregnancy. This, however, is of much less value than the complaint of "morning sickness." This may be merely a feeling of nausea soon after rising, or a complete or partial

vomiting of the morning meal, the nausea soon passing off. This symptom is most frequently seen from the second to the fourth month. Severer sickness passes into the region of pathology.

2. **Amenorrhoea.**—Menstruation may occur during the first two months of pregnancy, before the vera has blended with the reflexa and so obliterated the uterine cavity, and various bleedings can go on throughout pregnancy as in some pathological conditions of the cervix. Thus a pregnant woman is not necessarily amenorrhoeic. It must be remembered that some conceive before menstruation has commenced, and that others do so after it has ceased, as well as during lactation and other periods of amenorrhoea. Thus a woman may become pregnant although previously amenorrhoeic. It is also an important fact that, in addition to the numerous other causes of amenorrhoea, the fear of or the desire of pregnancy may lead to cessation of the menses, so that a healthy woman may suddenly cease to menstruate without being pregnant. However, if a healthy woman, who has menstruated regularly, misses a period without any diminution of the flow at the preceding period, the probability of pregnancy is sufficient to demand a careful examination.

3. **Quickening.**—The movements of the foetus can be felt by the mother from mid-term onwards. These produce the subjective phenomena known as "Quickening." Patients are often mistaken as to these feelings, and describe as "quickening" other and imaginary sensations. In primiparae no diagnostic value can be attached to this symptom; but multiparae frequently calculate the date of their labour accurately by allowing $4\frac{1}{2}$ months from its appearance.

Physical or Direct Signs of Pregnancy.

After conversation with the patient on the symptoms of pregnancy, it is convenient to examine the chest with a view to finding signs.

1. **Changes in the Mammae.**—From the second month onwards the breasts are enlarged and may be tender. They have a knotty feeling due to increase of gland tissue, the areola may already be darkened, and Montgomery's tubercles may be in evidence. From the third month onwards secretion may be expressed. In the fifth month the secondary areola appears. Striae will appear if the breast be much distended. These signs are of most value in primiparae, as the areola is permanently altered by the first pregnancy, the striae persist, and after this the secretion of fluid can easily be set up again. The changes occur in spurious pregnancy, in some pathological conditions, and even through fear or desire of pregnancy. If, however, these signs are present, further examination is needed.

2. **Changes in the Abdomen.**—The linea nigra may be seen early in pregnancy, especially in dark women, also some pigmentation round the umbilicus. Distension of the abdomen by the uterine tumour will not be seen till after the fourth month; indeed, a belief that during early pregnancy the abdomen is flatter than usual is expressed in the proverb, "En ventre plat un enfant va." During the first three months the uterus is in the pelvis, and the fundus below the brim; during the second three months the fundus will be found between the pubic symphysis and the umbilicus; during the third three months the fundus will be found between the umbilicus and the ensiform. This is an easy method of remembering approximately the rate of growth of the uterus. The striae gravidarum may be noted from the fifth or sixth month onwards. The uterine tumour is dull on percussion. Its consistence varies from hard to soft under the palpating hand, and may perhaps be best described as resembling that of a bag incompletely filled with fluid. The tumour often hardens when the patient rises, lies down, or changes her position. The regular rate of growth of the tumour of pregnancy is one of its most characteristic features.

Sometimes as early as the fourth month, and always by mid-term, auscultation reveals a uterine souffle, blowing in character, like that heard in the neck of anaemic patients. This is synchronous with the maternal pulse, and is produced in the vessels entering the uterus. As the left border of the uterus is rotated forward, and is thus nearer the abdominal wall, the uterine bruit is best heard on the left side. It can be heard after parturition and disappears gradually during involution of the uterus. A similar sound is produced in some fibroid tumours of the uterus.

If pregnancy is far enough advanced the foetal heart will be heard during the examination of the abdomen, and the diagnosis will be complete. Failing this positive sign, the pudenda will next be examined and the uterus palpated bimanually.

3. **Changes in the Vagina.** — The pudenda are soft, swelled, and moistened by a free secretion of mucous. The vaginal mucosa is also soft and lies in folds. The port wine colour due to congestion of the superficial vessels is noticeable over the vulva vagina and cervix, from the third month onwards. This purple hue is absent in about 17 per cent., and it is also caused by some tumours. Arteries can be felt pulsating half way up the vagina and in the fornices.

4. **Changes in the Uterus found on bimanual examination.**—The exploring finger runs over the stretched anterior wall straight on to the cervix, which is apparently shortened after the fifth month. Softening of the cervix occurs much sooner and may be noted as early as the first month. Placing two fingers in the vagina (or the forefinger in the vagina and the middle finger in the rectum), and then laying the other hand on the abdomen, so as to get the fundus uteri between the vaginal and the abdominal fingers, the uterus can be palpated while still a pelvic organ. If pregnant it is enlarged, softened,

and has to the finger a characteristic doughy feel, which, to the experienced, is a more sure sign than many of those much later in appearance. As a guide to the size of the uterus in the early months, it may be noted that the ovum itself is, at the end of the first month, the size of a pigeon's egg; at the end of the second, the size of a hen's; and at the end of the third month, the size of a goose's egg. The next two signs of pregnancy depend on the direct recognition of the foetus by the observer, and are therefore of the greatest value where the diagnosis lies between advanced pregnancy and certain tumours.

5. **Foetal movements.**—The observer may feel and see the active movements of the foetus through the abdominal wall. These movements are knows as "stirrage." They begin early in pregnancy, and it is said that they can be heard before the foetal heart is audible. The movements may be detected during bimanual examination early in the fourth month and can be felt through the abdominal wall a little later.[1]

The passive movement of the foetus called "Ballottement" can best be produced and recognised by the observer between the fifth and eighth months, as later there is too small a quantity of liquor amnii to admit of the foetus being freely moved to and fro. External ballottement is practised by placing the patient on her side and then holding the uterus between the two hands, spread out on the abdominal wall. The foetus is then set in motion by a jerk from the lower hand, it rises in the liquor amnii, and as it falls again its impact is recognised by the hand. Internal ballottement is obtained with the patient on the back. A finger is placed in the vagina and the foetus is jerked upwards as before, by a sudden pressure on the vaginal roof. Its

[1] The foetal head and other parts are best palpated through the abdominal wall with the patient in the dorsal position, the head and thorax well supported and the knees drawn up so as to relax the abdominal muscles. It will often be noted that palpation initiates active movements of the foetus.

impact on falling again is felt by the finger in the vagina a moment later.

6. **The foetal heart-sounds.**—The foetal heart becomes audible during the fourth month, when it should be listened for at the fundus. Later it is heard much more easily, in head presentations below, in breech presentations above the umbilicus, to the right or left according to the position of the child's back. The sound is said to resemble the ticking of a watch under a pillow. It must be distinguished from the maternal heart-sounds and from those of the observer and also from the ticking of watches. The rate is usually about twice that of the maternal heart, or about 130 beats per minute. Naegele gives the minimum rate as 90 and the maximum as 180 per minute in 600 cases. It is said that the larger the child the slower the heart, and that in male children it is slower than in females; thus it is often remarked of a slow foetal heart that it must belong to a boy or a large girl. The heart-sounds may be rendered inaudible by the presence of hydramnios or by the complication of pregnancy by tumour; its absence is thus but an imperfect sign of death of the foetus. The foetal heart is slowed during uterine contractions and during commencing suffocation of the foetus. It is quickened by feverish conditions, and during later stages of foetal suffocation.

Funic Souffle.—A single bruit may be heard instead of the usual double heart-sound. This is known as the funic souffle, and is thought to be produced in the vessels of the cord by pressure of the stethoscope or by coiling of the cord round the child's body. It is a rare and unimportant sign.

Summary of the Signs and Symptoms of Pregnancy.

I. Rational or Indirect Symptoms.

1. **Minor symptoms.**—Morning sickness.
2. **Amenorrhoea.**
3. **Quickening.**

II. Physical or Direct Signs.

1. **Changes in the Mammae.**
   - Primary areola.
   - Secondary areola.
   - Increase of gland tissue.
   - Secretion of milk.
   - Cutaneous striae.
2. **Changes in the Abdomen.**
   - Linea nigra.
   - Cutaneous striae.
   - Uterine tumour.
   - Uterine souffle.
3. **Changes in the Vagina.**
   - Softening.
   - Increased secretion.
   - Arterial pulsation.
   - Violet discolouration.
4. **Changes in Uterus** (noted on Bimanual Examination).
   - Softening of cervix.
   - Progressive enlargement of uterus with characteristic consistency.
5. **Foetal Movements, Sounds, and Parts.**
   - Active movements.
   - Passive movements (Ballottement internal and external).
   - Palpation of foetal parts.
   - Foetal heart-sounds.
   - Funic souffle.

Symptoms and Signs arranged Chronologically.

Having reviewed the symptoms and signs of pregnancy in the order in which they may be looked for clinically, it may be well to name them again in the order in which they appear and persist.

First month. — Amenorrhoea and tenderness of the breasts.

Second month.—As before, with morning sickness, pulsation in the vaginal roof, and enlargement of the uterus on bimanual examination.

Third month.—As before, with softening and violet discolouration of pudenda vagina and cervix, darkening of the areola and secretion of milk in the mammae.

Fourth month. — As before, with ballottement. The foetal movements possibly heard and felt. The foetal heart possibly heard. Uterine souffle heard. Uterine tumour palpable in the abdomen. Morning sickness passing off.

Fifth month.—As before, with the appearance of uterine contractions, apparent shortening of the cervix, and secondary areola.

Six and Seventh months.—as before. Cutaneous striæ.

Eighth and Ninth months.—As before, but ballottement lost, and foetal parts easily palpable. In multiparae, cervix may admit finger tip.

Differential Diagnosis of Pregnancy.

In mentioning the commoner conditions which may be mistaken for pregnancy, it is not necessary to refer to all the points in which they resemble it, nor to enumerate all their differences from it. It is sufficient to indicate how the distinction may be made.

1. **Hypertrophy of the uterus.**—This condition does not produce the violet discolouration of the vaginal mucosa seen in pregnancy, and may be distinguished from it by the absence of the soft fluctuating feel of the pregnant uterus from the second month onwards. The alternate hardening and softening of the pregnant uterus is also absent.

2. **Haematometra, physometra, and hydrometra.**—The distension of the enlarged uterus by blood, air, or fluid is often found along with amenorrhoea, being caused by

occlusion of the cervical canal, congenital or acquired. The cervix is not softened in these conditions, and continued observation will fail to reveal regular growth at the rate characteristic of pregnancy.

3. **Ascites.**—This can be demonstrated by percussion of the abdomen with the patient in various positions. The absence of the foetal heart-sounds, movements and parts will be noted. There is no uterine souffle, no softening of the cervix, and no regularity of growth of the abdominal tumour.

4. **Uterine new growths.**—Tumours of the uterus other than pregnancy do not harden and soften alternately. Ballottement and heart-sounds are absent, also the characteristic outline and rate of growth of the pregnant uterus. Amenorrhoea and softening of the cervix are also rare in uterine tumour. A dead child at the seventh month may so closely simulate a uterine fibroid as to delay the diagnosis for a time.

5. **Ovarian tumours.**—These often cause amenorrhoea, but it is usually of gradual onset when due to this cause. They usually give fluctuation, and they present unvarying resistance to the palpating hand, while their outline often reveals their multilocular nature. The absence of heart-sounds and foetal movements, of softness of the cervix and genitals, and of regular growth will complete the distinction.

6. **Parovarian Tumours.**—These also cause amenorrhoea, and may closely resemble pregnancy with hydramnios. The perfect fluctuation which characterises them, and the complete absence of ballottement, are distinctive when considered together with the condition of the cervix and genitals.

7. **Tumours of other Organs.**—Tumours of the liver, spleen, and kidney may possibly suggest pregnancy; but it is always possible to pass the hand below such growths, between them and the pelvic brim, thus proving that they are of abdominal, and not of pelvic origin.

8. **Phantom Tumours.**—These may usually be recognised by the clear note they give on percussion, but it may be necessary to anaesthetise the patient.

Complications.—Pregnancy complicated by the presence of tumours of abdominal or pelvic organs may give rise to very difficult points in diagnosis. These conditions must be considered as they occur, for any general description of them is necessarily imperfect. The diagnosis between pregnancy and hydatid and fleshy mole, and also that between uterine and ectopic gestation, will be considered later.

Nulliparous or Parous.—It is often necessary to determine whether a non-gravid woman has ever been pregnant. It is possible for a woman to become pregnant, and have an abortion during the early months without any trace being left by which it can be proved that she has ever been pregnant. If, however, pregnancy has lasted seven or eight months, it is generally possible to discover the fact at any subsequent period. The parous woman has somewhat pendulous breasts, relatively dark areola and developed nipple; but the breast of the nullipara may also have these peculiarities. If, however, the breast is marked with cutaneous striae, it is almost certain that it has been distended with milk. The remains of a secondary areola forms an equally good proof of a previous pregnancy. The parous woman has a flaccid abdominal wall, the recti may be separated, and the skin of the abdomen is loose and marked with cutaneous striae. The fourchette is destroyed, and the fossa navicularis obliterated. The hymen is not only torn in one place, but is broken up, and represented only by small, irregular projections, the carunculae myrtiformes. The vaginal walls are relatively smooth, the os uteri is transverse, and the cervix is usually traversed by one or more tears, dividing it into lips. The body of the uterus is rather larger and longer than in the nulliparous woman. No number of subsequent pregnancies can add fresh signs of parity, but they render more marked those noted above.

Primiparous or Multiparous.—It may be necessary to determine whether a gravid woman has had a previous pregnancy—that is, whether she is a primipara or a multipara. As this question is more difficult, though sometimes no less important, than the previous one, it may be well to tabulate the necessary points.

	Pregnant for the First Time.	**Pregnant Multipara.**
Mammae .	Firm and smooth, fresh striae only, purple in colour.	Pendulous; old pearly white striae, as well as fresh purple ones.
Abdomen .	Wall firm, recti not much separated, fresh striae only, purple in colour.	Wall flaccid, recti may be much separated; old pearly white striae, as well as fresh purple ones.
Uterus .	Walls full of tone, relaxation incomplete.	Walls soft, and completely relaxed when not contracting.
Pudenda .	Perineum intact; fourchette not torn; hymen torn only, *not broken up.*	Perineum may have been torn; fourchette torn; hymen broken up, *and almost obliterated.*
Vagina .	Walls rugose, orifice small.	Walls smoother, may be cicatricial bands, orifice large.
Cervix . .	Margin smooth and intact, os nearly circular, with often a thin edge.	Margin interrupted by tears, dividing cervix into lips, os transverse and with thickened edges.

Pseudo-Cyesis.

Time of occurrence.—Imaginary or spurious pregnancy may occur at any time during reproductive life and even outside its limits. It is commonest in the newly-married, but the more serious cases are those of women near the change of life.

Varieties.—The condition varies from a fancy due to

the possibility, desire, or fear of pregnancy, and easily removed by an authoritative opinion, to a firm delusion of long duration, which it is impossible to remove. It may or may not be accompanied by symptoms and signs supposed to be those of pregnancy, and may, if not removed, end in a spurious labour.

Causes.—It is often preceded by some pelvic disorder or by gastric disturbance. The vomiting of dyspepsia is often called "morning sickness." Frequently it is purely nervous in origin. It is not confined to homo, as it has been seen to occur in bitches.

Symptoms.—Amenorrhea is a leading symptom and may persist for more than nine months. "Morning sickness" is common, and some abdominal sensations are usually described as "quickening." Neuralgia, toothache, and irritability of temper occur.

Signs.—The breasts enlarge, and in multiparae there may be secretion of milk. Enlargement of the abdomen is almost invariably present.

Diagnosis.—On questioning the patient there will often be found some incongruity in her statements, various symptoms and signs not corresponding with the stated date of their appearance. Some symptoms may be altogether absent. On examining the breasts it may be found that the increase in size is due to the growth of fat only, and in nulliparae there will be no secretion. The enlargement of the abdomen will be found due to the deposition of fat, internal and external, and to flatulent distension. The patient may involuntarily protrude the abdomen, and may unconsciously curve forward her loins to increase its prominence. The umbilicus will be retracted even when the abdomen is as large as at the eighth month; there will be no fresh purple striae, and probably no linea nigra. The percussion note may not be clear, but it will not be absolutely dull as in genuine pregnancy. Auscultation and examination per vaginam will, of course, give negative

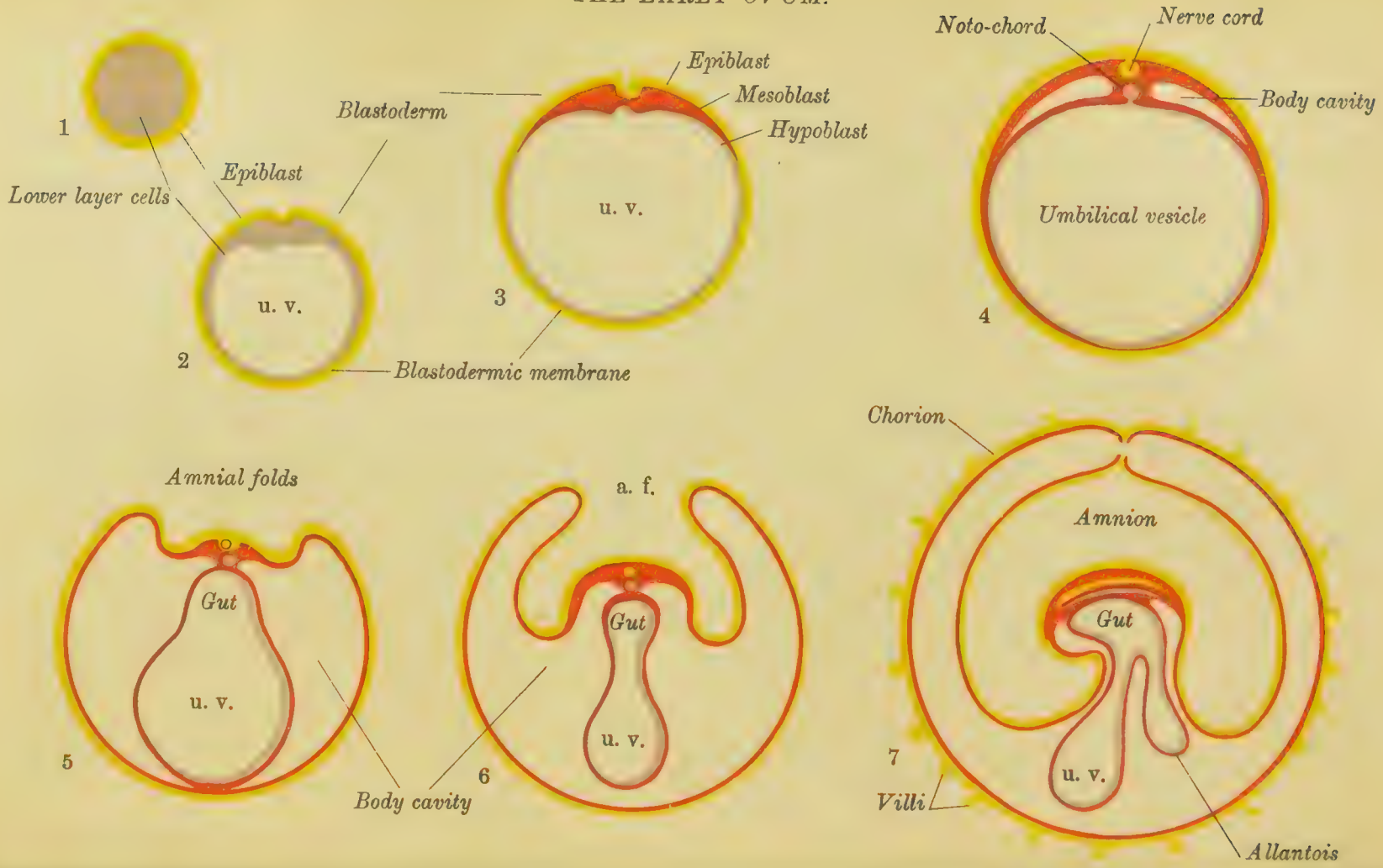
results. It may be necessary to anaesthetise the patient and watch for diminution of the tumour with each expiration as the patient becomes unconscious. A satisfactory bimanual examination can then be made, when varied morbid conditions of the uterus and appendages may be found.

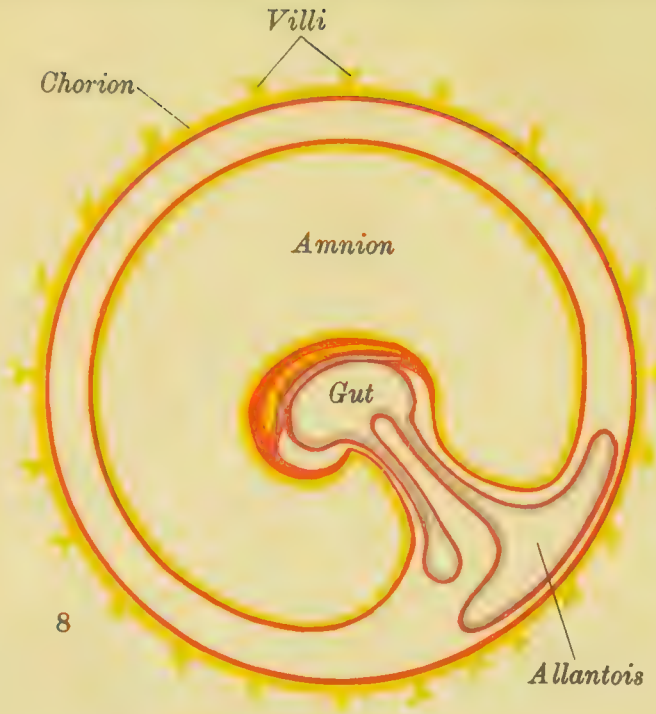
Prognosis.—If the assurance that pregnancy does not exist does not remove the impression and relieve the symptoms, both may disappear after a spurious labour, whose date will be that calculated by the patient as the end of her pregnancy. Labour pains occur, and in some cases a membranous cast of the uterus may be shed. The symptoms may continue more than nine months from their commencement, no spurious labour having occurred, and the patient may have recurrent "labours" at monthly or other intervals for years.

Treatment.—The treatment of this condition consists mainly in the diagnosis. It is always possible to convince the friends of the patient of the nature of the case by giving an anaesthetic in the presence of some responsible relative, though it is difficult to prove to the patient that there is nothing living and moving inside her. The pelvic conditions, dyspepsia, flatulent distention, and adiposity may call for appropriate treatment.[1]

[1] Pseudo-cyesis is often discussed with the Pathology of Pregnancy; but, as it is not pregnancy at all, it can equally well and perhaps more usefully be described in connection with the diagnosis of pregnancy.

THE EARLY OVUM.





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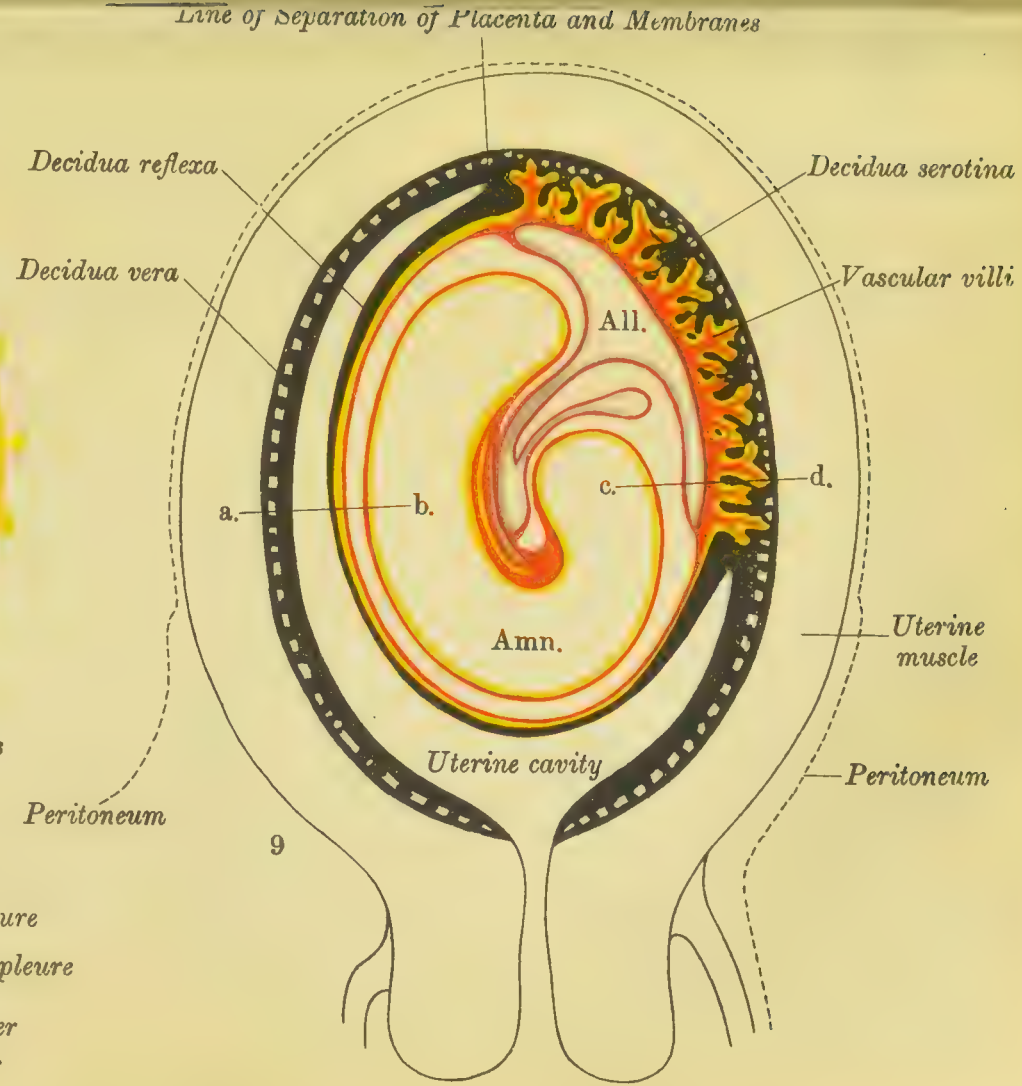

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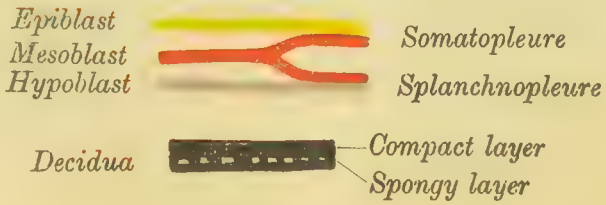


W. E. F., del.

a — b cuts membranes
c — d cuts placenta

McLAGAN & CUMMING, LITH. EDIN.

CHAPTER IV.

PREGNANCY—*Continued.*

DEVELOPMENT OF THE EARLY OVUM

As the early history of the human ovum is not known by direct observation, it is necessary to introduce our consideration of its development by a statement generalised from our knowledge of the development of other mammals.

The fertilised ovum is a single cell with a clear cell-wall, the zona pellucida; cell protoplasm, the yelk; and a nucleus. This is a secondary nucleus, and represents the head of the fertilising spermatozoon fused with the germinal vesicle of the ovum, previously matured by extrusion of the two polar bodies. (See page 19.)

Holoblastic segmentation.—The ovum now undergoes complete segmentation. The nucleus divides into two portions, as does the protoplasm, giving two cells instead of one within the zona pellucida. These two cells divide into four, the four into eight, and so on until a rounded mass of cells or *morula* (mulberry) is formed. The morula consists of two kinds of cells. Those on the surface are the *epiblast* of the ovum; those enclosed within them are the so-called "*lower-layer-cells*," from which will be derived the *hypoblast* and the *mesoblast* of the ovum. As the zona pellucida thins before the growing morula, and is not long recognisable as such, it will not be mentioned again.

Blastodermic vesicle.—Omitting the next stages we may

simply state that a little later the ovum has become a hollow sac, the *blastodermic vesicle*, containing fluid.

Blastodermic membrane.—The wall of this sac, the *blastodermic membrane*, consists of two kinds of cells—the outer *epiblast*, the inner *lower-layer-cells;* at one spot, the *blastoderm* itself, the lower-layer-cells are several layers deep.

The **Blastoderm.**—This thicker portion of the blastodermic membrane is often called the *area germinativa*, because in it the embryo appears.

Origin of Mesoblast and Hypoblast.—Those lower-layer-cells of the blastoderm which are next the epiblast now become differentiated from the lower-layer-cells next the fluid contained within the vesicle. Thus the lower-layer-cells give origin to the hypoblast cells lining the vesicle, and the mesoblast cells lying between the hypoblast and the epiblast. Though at first formed in the area germinativa or blastoderm, the mesoblast grows rapidly at the circumference of this area, and spreading between the epiblast and the hypoblast of the blastodermic membrane, soon gives a third layer of cells to the entire wall of the blastodermic vesicle. Thus the ovum is now a vesicle whose wall consists of three kinds of cells — epiblast outside, mesoblast next, and hypoblast lining the cavity. The mesoblast is several layers of cells thick in the germinal area. A central clear portion of this area is called the *area pellucida*; round this is a darker portion, the *area vasculosa.*

Primitive Streak.—Before this a streak can be seen on the area pellucida, the *primitive trace*, marking the position where the formation of the embryo has already begun.

We follow the changes in epiblast, hypoblast, and mesoblast of the embryo in three columns, better to grasp their simultaneity.

Epiblast.	Mesoblast.	Hypoblast.
Thickens along the primitive trace to form the medullary plate in which the medullary groove appears. Lateral ridges meet over this groove, and turn it into the neural canal.	Forms masses round the developing notochord — the protovertebrae—and lateral plates on each side. Protovertibrae form the spinal column. Lateral plates form the muscles and connective of the foetus.	A mesial ridge folded off from this under the neural canal forms the notochord, round which the protovertebrae are formed from the mesoblast.
From the neural canal, the central nervous system is developed.	The lateral plates split in a plane parallel to the surface of the blastoderm. The outer layer goes with the epiblast, the inner with the hypoblast.	The hypoblast forms the lining of the alimentary canal of the foetus.

Somatopleure.	Splanchnopleure.
This, consisting of the epiblast and the outer layer of the mesoblast, forms the body wall of the foetus.	This, consisting of the hypoblast and the inner layer of the mesoblast, forms the wall of the alimentary canal and of other viscera.

Splitting of Mesoblast.—Instead of being a single membrane composed of three strata of cells, the blastoderm thus becomes, by the splitting of the mesoblast on each side of the spinal column of the foetus, two membranes, each composed of two strata of cells.

Somatopleure and Splanchnopleure.—This splitting of the mesoblast continues over the whole surface of the blastodermic vesicle, so that the whole blastodermic membrane is split, like the blastoderm, into somatopleure and splanchnopleure. We have thus two vesicles, one inside the other, and attached to one another only where

the spinal column of the foetus is forming. The outer vesicle is of somatopleure, the inner of splanchnopleure.

By this time the blastodermic vesicle is marked by a constriction which begins to separate what will be the body of the embryo from the rest of the vesicle. Remembering that we are now dealing with somatopleure and splanchnopleure and not with the single blastodermic membrane, it is clear that above the constriction we have embryonic somatopleure, and below it extra-embryonic somatopleure, and also that above the constriction we have embryonic splanchnopleure, and below it extra-embryonic splanchnopleure. Between the somatopleure and the splanchnopleure is a space. That part of this space above the constriction is within the embryo, and will form its pleuro-peritoneal or body cavity, which is therefore as yet continuous with the extra-embryonic portion of the space between somatopleure and splanchnopleure.

	Embryonic.	Extra-Embryonic.
Somatopleure .	Walls of body.	Extra-embryonic splanchnopleure.
Space	Pleuro - peritoneal cavity.	Extra-embryonic pleuro-peritoneal cavity.
Splanchnopleure	Walls of alimentary canal.	Umbilical vesicle.

Umbilical Vesicle.—The extra-embryonic splanchnopleure is now called the *umbilical vesicle*, whose cavity is continuous with that of the embryonic alimentary canal.

Chorion and Amnion.—The foetus and the umbilical vesicle now sink down, the extra-embryonic somatopleure rising round the embryo. The folds soon meet over the back of the embryo, and, adhering where they touch, unite. The embryo is thus enclosed in a sac formed of extra-embryonic somatopleure, lined with epiblast continuous with the skin

of the embryo, while the outside covering of the ovum is as before extra-embryonic somatopleure with the epiblast to the outside. The sac enclosing the embryo is the *amnion*, the outer covering of the ovum is the *chorion*, which is thus defined as that portion of the extra-embryonic somatopleure which does not enter into the formation of the amnion. Thus amnion and chorion are both composed of epiblast and mesoblast, the amnion has epiblast inside and mesoblast outside, while the chorion has epiblast outside and mesoblast inside. The umbilical vesicle and the alimentary canal consist of hypoblast and mesoblast, the hypoblast being inside in both cases. The space between amnion and chorion is, of course, continuous with the body cavity of the embryo.

Allantois.—The next change is the out-pushing of a diverticulum from the alimentary canal of the embryo. This pouch is, of course, composed of embryonic splanchnopleure, and is therefore lined by hypoblast and covered with mesoblast. It grows out into the body cavity, and then passes out between the stalk of the umbilical vesicle and the neck of the amnion into the extra-embryonic cavity, which is still continuous with the body cavity. This diverticulum of the embryonic alimentary canal is the *allantois*.

The future of the umbilical vesicle is unimportant, as it becomes less and less relatively to the allantois, which grows rapidly larger. The embryo is now taking shape, and lies in the fluid contained in the amnion. The neck of the amnion narrows and lengthens till it forms a tube of somatopleure continuous with the amnion below and with the body wall of the foetus above. Within this tube lie two smaller tubes, side by side, the stalks of the umbilical vesicle and of the allantois. At the end of its stalk the allantois spreads out into a widely expanded sac, lying between the amnion and the chorion, partly filling the space between them, which is still continuous through the

elongated neck of the amnion with the body cavity of the embryo. Soon all of this space, except the body cavity of the embryo, becomes obliterated.

(1) **Cord.**—The neck of the amnion closes on the stalks of the umbilical vessel and the allantois to form the solid rudiment of the *umbilical cord.*

(2) **Membranes.**—The amnion approximates and fuses with the chorion. The united amnion and chorion thus form the structure known as the *foetal membranes.*

(3) **Placenta.**—The sac of the allantois becomes flattened between the amnion and the chorion, and both unite with it in the site of the rudiment of the *placenta.*

Chorionic Villi.—Some time before these changes are complete, the surface of the ovum, which is the chorion, becomes covered with small projections growing from the foetal epiblast, which are the chorionic villi. These are embedded in the maternal mucous membrane.

Vascularisation of Chorion.—By this time the heart and vessels of the embryo have been formed from the mesoblast, and have given a large blood supply to the allantois. The two arteries to the allantois and the veins (first two, later only one) from it run alongside of the stalk of the allantois in the developing umbilical cord, while over the allantoid surface a network of smaller vessels and capillaries are spread. The hypoblast lining the allantois is of no further importance, but its vascular mesoblast layer spreads outwards on all sides.

Thus the allantois vascularises the chorion and its villi. Each villus begins as a small bud of foetal epiblast, then a core of mesoblast containing a capillary loop grows into it, and the structure thus formed branches and enlarges. Thus at one time the whole ovum is covered with a shaggy coat of villi.

Atrophy of Chorionic Villi.—But soon the villi cease to grow, and later disappear almost completely, except over that part of the chorion which is to form the placenta.

Growth of Placental Villi.—The part of the chorion in contact with the *decidua reflexa*, having become smooth by the atrophy of its villi, is known as the *chorion loeve;* while that in contact with the *decidua serotina—chorion frondosum* —produces new villi, by whose rapid growth the placenta is formed.

From **epiblast** are formed:—1. The central nervous system and parts of the sense organs, the lining of the mouth and the epidermis of the skin of the foetus. 2. The epithelial covering of the umbilical cord and the epithelial lining of the amnion. 3. The external covering of the ovum, being the epithelial layer of the chorion, including the epithelium covering the villi of the placenta.

From **mesoblast** are formed:—1. The musculature, connective tissue, and circulatory system of the foetus. 2. The connective and vascular elements of the cord. 3. The connective layers covering the amnion, the umbilical vesicle, and the allantois, also the connective layer lining the chorion, including the connective core and blood vessels of each villus of the placenta.

From **hypoblast** are formed the lining of the lungs, alimentary canal, and its glandular appendages, also the lining of the bladder (stalk of the allantois). The lining of the umbilical vesicle, the allantois, and the stalks of these appendages are also hypoblastic

Earliest Human Ova.

The human ovum on leaving the ovary is about $\frac{1}{120}$ in. in diameter; on reaching the uterus it measures from $\frac{1}{50}$ to $\frac{1}{25}$ in. The impregnated human ova described by Velpean, Coste, Reichert, His, and others, are about twelve days after fertilisation. Reichert's ovum was twelve or thirteen days old, and measured 3.3 mm. by 5.5 mm. It was ovoid in shape, and was partially covered by chorionic villi

forming a zone round it. These were hollow and about .2 mm. in length. This ovum was attached by one end to the decidua serotina, and was covered by a reflexa. The ovum of His was fourteen days old, and measured 5.5 mm. by 8.5 mm. The embryo had an enclosed neural canal, and showed no trace of limbs or branchial clefts. His represents the embryo as attached to the chorion by its caudal extremity. It has been supposed that the embryo, with its amnion and the umbilical vesicle, floats for some time free from the chorion, the connection being restored only when the growing allantois reaches the chorion. According to His, however, we must imagine the embryo to dip head foremost towards the centre of the ovum surrounded by the amnion, leaving its posterior end attached to and continuous with the chorion. The allantois, growing out from the hinder end of the gut, will thus reach the chorion by a more direct route than is usually supposed, tunneling, in fact, the still unclosed hinder end of the embryo.

Comparative Notes.

The eggs of most vertebrates contain a supply of yolk, as food for the embryo. This is stored in the yolk sac, which is lined with hypoblast, and is continuous with the gut, so is easily absorbed by the growing embryo.

Ichthyopsida.—In some fishes, processes of the epiblast covering the ovum grow into contact with the lining of the oviduct, and seem to absorb nutriment from the maternal tissues.

Sauropsida.—In shelled eggs, nutriment is stored around the yolk sac as well as within it—the "white of egg"—and villi develope from the yolk sac and absorb it. In such eggs the allantois is present, and is a highly vascular membrane, serving mainly the function of respiration, though in Sauropsida it produces some villi which absorb nutriment for the embryo. In the mammalia, eggs with no shell are

retained in a uterus. The chorion throws out epiblastic villi to the maternal tissues as before; but, when retained in the maternal passages, the ovum is deprived of the supply of air which easily penetrates an egg-shell to oxidise the embryonic blood. Therefore, to secure the respiration of the ovum, a close relation must be established between the foetal blood carried by the allantois and the maternal blood in the uterine mucosa. Thus the allantois vascularises the villi of the chorion. But villi thus vascularised absorb nutriment as well as allowing of oxidation of the foetal blood, and thus the allantois becomes in mammalia the organ of nutrition as well as of respiration. Yolk thus soon becomes unnecessary in the mammalian egg, and we find the yolk sac of other vertebrates replaced by the umbilical vesicle containing merely fluid, separated from the chorion and shrinking into early insignificance.

Prototheria and Metatheria.—In Monotremes and Marsupials the allantois is still mainly respiratory, and there is no true placenta.

Eutheria.—In the higher mammals the condition is at first the same, for the villi of the chorion alone touch the maternal mucosa; the true placenta is formed only when the allantois renders vascular certain of these villi.

Forms of Placenta.—The permanent villi are variously distributed over the chorion in different animals. They are irregularly scattered in the *diffuse placenta* of the Perissodactyla; gathered into bundles or cotyledons in the *cotyledonary placenta* of the Artiodactyla; arranged in a belt round the ovum in the *zonary placenta* of the Carnivora; and gathered together into a disc in the *discoidal placenta* of man, the anthropoid apes, Rodents, and Insectivora.

Deciduate and Non-deciduate Placentae.—*Non-deciduate* Placentæ are those whose villi simply fit into crypts of the maternal mucosa, and can be withdrawn from them at

parturition without causing bleeding or bringing away with them any maternal tissue. In *deciduate* placentae the connection between villi and mucosa is more intimate, as the villi bring away with them, at separation of the placenta, a layer or decidua of maternal tissue, leaving a raw surface from which more or less bleeding occurs. The non-deciduate placentae belong to Artiodactyla, Perissodactyla, Sirenia, Cetacea, Lemuridae, and some Edentata. The other Mammalia have deciduate Placentae, the wall of the uterus undergoing structural changes, so that the villi are immersed in spaces filled with maternal blood. The united deciduae reflexa and vera come away attached to the membranes, the serotina attached to the placenta.

Relation of Ovum to Decidua.

Decidua.—We have seen that the maternal mucosa undergoes considerable changes at the beginning of pregnancy. We noted the formation of decidual cells, the distinction between the superficial compact, the spongy and the deep layers of the decidua, and the increased vascularity of the surface. We also referred to the proliferation of the endothelium of the vessels, and to the fact that there is no maternal epithelium in contact with the ovum. The maternal epithelium may be destroyed and eaten up by the foetal epithelium, or it may be absent because the ovum is grafted on a surface of connective tissue from which the epithelium has been removed by menstruation.

Trophoblast.—The connective tissue of the early decidua is covered with a layer of material containing nuclei, and showing, in places, cell outlines. In parts this material, which is called the *trophoblast*, forms trabeculae extending from the ovum to the surface of the decidua, with spaces between them. This layer of nucleated and vacuolated protoplasm is continuous with the early villi of the chorion, and is indeed formed by proliferation of the foetal epiblast. It

has been observed by Kastschenko, Minot, van Beneden and others. The phagocytic action of this foetal epiblast or trophoblast has been shown by several authors in many

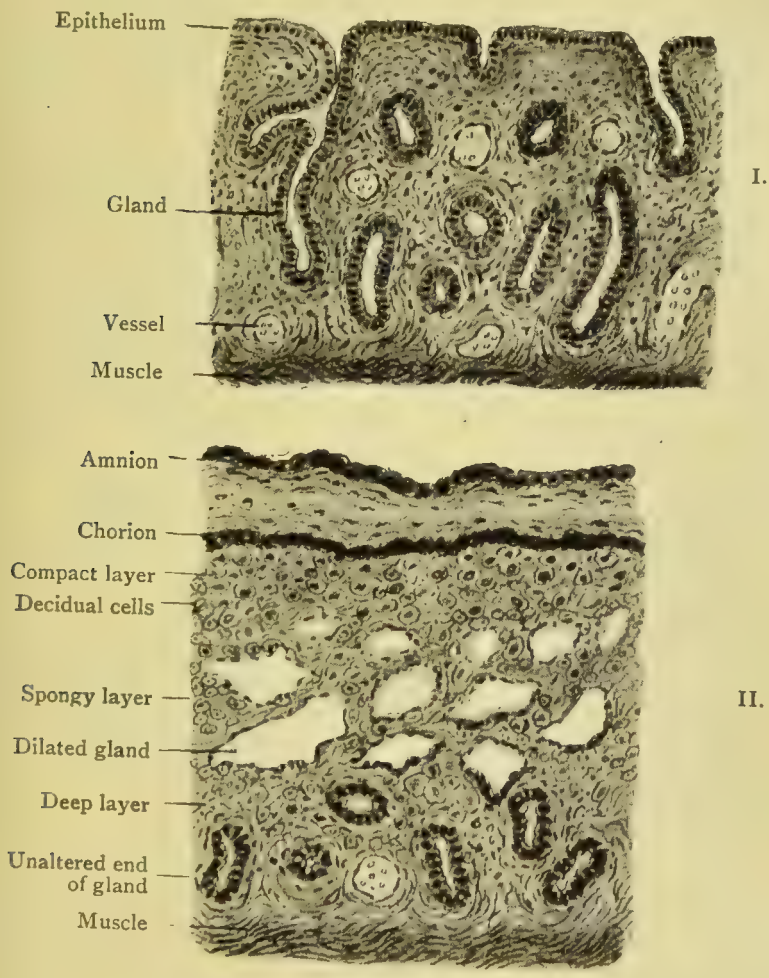


FIG. 6.—Sections of uterine mucosa.

I. Normal.

II. During pregnancy; to show membranes of the ovum; Decidua vera and reflexa fused, Spongy layer and Deep layer of uterine mucosa.

lower animals, and by Hart and Gulland and others in homo. Webster goes further, and has shown that, by eating away the maternal structures, the trophoblast opens into the

blood vessels of the decidua, allowing maternal blood to flow into the spaces between the trabeculae, and so to come into contact with the epithelium of the ovum.

The early trophoblast thus fixes the ovum in position, may perhaps use as nutriment the maternal structures absorbed by it, and opens the way for the maternal blood to pass from the vessels of the decidua into contact with the ovum. The trophoblast is most "plasmodial" in appearance where it is furthest away from the ovum. Next the ovum it contains more nuclei, and the cells are better defined; while, where it is continuous with the growing villi of the chorion, the cells are well formed and contain darkly-staining nuclei. As the ovum grows, the trophoblast is broken up into fragments which vary in appearance, and lie scattered over the surface of the decidua, some of them being within the walls of the maternal sinuses.

Chorionic Villi.—The two functions of attachment of the ovum and the absorption of nutriment are next assumed by the chorionic villi. The chorion has an epithelium two or more layers of cells thick, set on a mesoblastic layer of connective tissue. The villi are processes of this, and consist accordingly of two or more layers of epithelial cells covering a core of connective, which contains blood vessels with their own endothelium.

Development of Placenta.

Placental Villi.—The villi in contact with the reflexa soon atrophy (chorion laeve), and the permanent placenta is formed by the growth of old villi, and the formation of new ones over that portion of the chorion which is in contact with the serotina. As development advances, the epithelium of the villi gets thinned and reduced to one layer of cells. The villi multiply rapidly and form the bulk of the placenta. The ends of many of them are attached to the serotina by clumps or heaps of foetal epiblast due to proliferation of the epithelium covering the ends of the villi.

Intervillous blood space.—The maternal blood flows directly from the arteries of the decidua into the intervillous spaces, and finds its way out of them into the uterine veins. There is thus between the maternal blood and the foetal blood, (1) foetal epithelium of the villus; (2) foetal connective tissue, the core of the villus; and (3) the endothelium lining the foetal vessels in the villus. The intervillous spaces

FIG. 7.—Section of Early Placenta and Serotina. From Nature.
Ep. = foetal epiblast.

containing the maternal blood are not derived from any vessel, but are simply spaces between the ovum and the decidua serotina, traversed by those villi whose ends reach the decidua.

Summary.—Thus the ovum is first fixed and fed by the

trophoblast, a temporary reticulum of epiblastic origin. Next, it is fixed and fed by the villi covering the whole surface of the chorion, and which may all be new processes of the chorion, or may, some of them, be the trabeculae of the original reticulum provided with cores of mesoblast. Lastly, the ovum is nourished by the placenta, which consists of the hypertrophied villi in contact with the serotina and others newly formed from the chorion over the same area.[1]

[1] The above view of the development of the placenta is put forward as being the most simple, the most recent, and the most correct. The view that the intervillous blood spaces are lined with maternal epithelium is now practically obsolete. It originated in the observation of villi at a stage of development when they are covered by two layers of epithelium. One was thought to be foetal, the other maternal, by Goodsir. Turner observed a single layer of epithelium covering villi, and described it as maternal. Thus Turner, with whom are Ercolani and Waldeyer, described the blood spaces as enlarged maternal vessels whose endothelium is intact and spread over the villi. Leopold and Virchow also hold that the blood spaces are maternal vessels; but that the villi perforate the maternal endothelium, and hang naked in maternal blood. The view that the spaces are extra-vascular, and are simply a great space in which some villi hang free, others crossing it to unite with the decidua, is held by Koelliker, Langhans, Heinz, Minot, Hart and Gulland, and Webster;—a weight of recent authority which justifies the description given above.

CHAPTER V.

PREGNANCY—*Continued.*

THE MEMBRANES. { **Deciduae.** / **Membranes of the Ovum.** { Amnion. / Chorion.

Deciduae.—The united vera and reflexa adhere to the chorion, and at separation of the placenta they come away with the membranes of the ovum. The plane of separation is through the spongy layer of the vera. These deciduae are thinned out so as to be hardly recognisable, and consist of degenerated cells and fibres of maternal origin.

Chorion.—The chorion consists of a layer of rounded or flattened epithelial cells on a basis of mucous connective tissue with fibrils, and stellate and spindle cells. A few fibrous remains on its surface may represent the atrophied villi of its early history.

Amnion.—The amnion also consists of a single layer of epithelial cells set on a layer of mucous connective tissue. The epithelial surface is inward, and is continuous with that covering the cord, and so with the epidermis of the foetus. Both amnion and chorion are of course extra-embryonic somatopleure, the amnion being a portion of this turned outside-in round the embryo. At first there is thus a space between them filled with fluid. Later, as their connective tissue surfaces approximate one another, they are separated only by a little gelatinous material. Still later the two membranes become adherent. They are, however, always easily separable, and any degree of separation may persist till full time. (See Figs. 6 and 7.)

Liquor Amnii.

Characters. — The fluid contained in the amnial sac increases in amount up to the seventh or eighth month, after which it decreases somewhat. A pint or two usually escapes at delivery. The specific gravity of the fluid ranges from 1004 to 1025, lessening as pregnancy advances. Chlorides, phosphates and other salts are present in it, with some albumen and some urea. The albumen decreases during pregnancy from about .8 per cent. to about .08 per cent. The urea increases from a mere trace at the beginning up to about .4 per cent. at the end of pregnancy. Clear at first, the liquor amnii becomes turbid before parturition by the addition to its composition of foetal hair, epithelial debris, and other excrementa.

Sources.—The fluid is derived from the maternal liquor sanguinis, partly through the maternal and partly through the foetal vessels. The urine of the foetus is normally added to the liquor amnii when secreted before birth, which accounts for the presence of urea in increasing quantities. Meconium from the foetal rectum frequently discolours the fluid, some of which may be swallowed by the foetus, as is proved by the occasional presence in its intestines of lanugo and epidermal debris. This fact doubtless gave origin to the amusing theory that the use of the liquor amnii was to nourish the foetus.

Uses.—The foetus during the earlier months floats free in the fluid, which thus forms a suitable nidus for its development, and a protection from injury. During parturition the uterus contracts on what is, due to the presence of the liquor amnii, practically a fluid body, capable of transmitting force in any direction. A "general contents pressure" is thus transmitted by the fore-waters in the bag of membranes to the cervix and lower uterine segment —the place of least resistance—and so dilation is accomplished much better than when the force is transmitted by a more solid body as in dry labour.

VESICLES OF THE OVUM { **Umbilical Vesicle.** **Allantois.**

Umbilical Vesicle.—The umbilical vesicle shrinks rapidly, and can only rarely be seen at full time, when it forms a small cyst under the amnion, near the insertion of the cord into the foetal surface of the placenta. Its stalk early becomes impervious, but can be seen in transverse sections of the early umbilical cord. The portion of the stalk within the foetus usually disappears, but it may remain as a pouching of the intestine, known as Meckel's diverticulum. The pouch may be free, or attached at the umbilicus to the abdominal wall, or may open to the exterior (faecal umbilical fistula).

Allantois. — The allantois is, to begin with, a vesicle whose stalk is a tube entering the body of the embryo at the umbilicus and opening into its intestine. The vesicle disappears early and leaves no trace in the placenta. The stalk can be seen for a time in sections of the cord. Within the embryo it is cut off from the intestine, and the lower part of it forms the urinary bladder, the part from the bladder to the umbilicus shrinking into a strand of connective tissue, the urachus. This may remain tubular and even patent (urinary umbilical fistula). After birth the arteries which run along the stalk of the allantois to the placenta remain patent as the hypogastric arteries as far as the bladder. For the rest of their course they form fibrous strands between bladder and umbilicus, one on each side of the urachus. At first two veins take blood from the placenta along the stalk of the allantois to the embryo. The left vein only persists and enters the inferior vena cava through the liver by the ductus venosus, which after birth shrinks to a fibrous cord.

THE CORD OR FUNIS.

Size. — The umbilical cord or funis is about ½ in. in diameter, but may be much thicker. It is usually from

18 in. to 24 in. in length, but is often longer and occasionally shorter. The extremes described are 72 in. and 3 in.

Insertions. — The cord is said to have a central, an eccentric or a marginal insertion according as it is attached to the centre, to a point removed from the centre, or to the edge of the placenta. It may be attached to the membranes with its vessels running across a portion of these to the placenta; its insertion is then called velamentous. The marginal insertion of the cord constitutes a "battledore" placenta. Early in development the cord runs to the caudal extremity of the embryo. When the limbs have formed it is attached just above the pubes. The position of its attachment rises gradually during pregnancy, till at birth it is $\frac{3}{4}$ inch below the centre of the foetus.

Structure.—The cord is covered by a layer of cubical epithelium continuous with the epithelium of the amnion and with the epidermis of the foetus. Its bulk consists of mucous connective tissue known as Wharton's jelly. This contains fibrils and stellate connective tissue corpuscles in an abundant mucoid matrix. The left umbilical vein persists and both the umbilical arteries. The stalks of the allantois and the umbilical vesicle may be traced in early sections of the cord, but the three vessels are usually the only structures visible. The walls of the vessels consist mainly of unstriped muscle fibres. There is no elastic layer or outer coat, so that on cutting the cord the vessels project instead of retracting. There is an endothelial lining, though this has been denied. The arteries widen as they pass from the foetus toward the placenta from 3.2 to 3.8 mm. Vasa propria are described at an early stage, and the existence of vasomotor nerves is suspected. Lymphatics are said to exist, and there are doubtless spaces between the connective elements containing fluid and leucocytes. (See Fig. 9, p. 80.)

Twist.—The cord is twisted spirally from left to right in nine cases out of ten. It may twist the other way, or both

ways alternately. The twisting has been badly explained in many ways, and is probably due to that tendency to spirality in growth which is seen alike in vegetable and animal organisms. It doubtless gives the cord greater resistance to various injuries than it would possess if untwisted. Long cords may pass once or more round the neck or body of the embryo, and may sometimes be tied into knots. Swellings on the cord are often due to irregularities of the Wharton's jelly or to dilatations of the vein, and not to true knots.

Defects.—There may be abnormalities in the number and arrangement of the vessels. The cord may even be double, with the vein in one half and the arteries in the other.

Irregularities in the cord are not without effect on the life of the child. In 50 cases of such irregularity only 20 arrived at full term. $4\frac{1}{2}$ per cent. of normal children are still-born, while $8\frac{1}{2}$ per cent. of those with defective cords are still-born.

The Placenta.

Form and Dimensions.—The placenta at full time is 7-8 inches in diameter and 1 to $1\frac{1}{2}$ in. thick. It is nearly circular in outline, thickest near the centre, and thinned or bevelled round the margin to become continuous with the membranes.

Structure. — The organ weighs from 12 to 20 ounces. It grows till the 36th week, after which retrogressive changes occur in it. The foetal surface is smooth, being covered by the amnion, under which the foetal arteries and veins spread and ramify in all directions. The maternal surface is rough and lobulated, the villi being compacted into clumps about an inch in diameter, which are separated more or less by septa of decidual tissue. A section of placenta *in situ* shows structures as below. (See Fig. 7, p. 69.)

Section.

Epithelial layer Fibrous layer	Amnion	**Foetal**	PLACENTA.
Fibrous layer Epithelial layer	Chorion		
Mass of villi between which is maternal blood	Villi		
Compact layer of Decidua Serotina	Decidua—**Maternal**		
Spongy layer of Decidua Serotina	**Line of separation**		
Deep thin compact layer of Mucosa Uterine muscle	**Uterine wall**		PLACENTAL SITE.

Serotina, deep layer.—In the deep layer of serotina which remains attached to uterine muscle, and from which the uterine mucosa is renewed, the ends of the uterine glands remain almost unchanged, lined with columnar epithelium. (Compare decidua vera in Fig. 6, p. 67.)

Spongy layer.—In the trabecular or spongy layer the uterine glands are dilated into large spaces whose epithelial lining is flattened and disintegrated considerably. The blood vessels run in the septa between these spaces, which are narrow and easily torn through when the placenta separates.

Compact layer.—The caducous maternal tissue, which comes away with the placenta and covers its maternal surface, contains many large decidual cells and spindle cells and fibrils. It is a thin greyish-white layer about $\frac{1}{24}$ in. thick, not easily separable from the mass of villi it covers. It forms septa between the lobules or clumps of villi, through which the maternal arteries and veins mostly open into the intervillous space. Some of the septa traverse the spongy mass of villi as far as the chorion, and some patches of decidual

tissue are found adhering to that membrane between the bases of the villi. The maternal elements thus form a framework of connective tissue into which are fitted the foetal villi and vessels which form the bulk of the placenta. There is a blood channel round the margin of the placenta known as the sinus of Meckel, but this is not a continuous sinus, as it is interrupted by the septa between the lobules. There is, in fact, a sort of circular blood space (part of the great intervillous space) round each lobule, and parts of the spaces round the marginal lobules form the so-called marginal sinus. The uterine glands in the deciduate tissue are opened out and their epithelium is lost.

Villi.—Three kinds of villi are found.

1. A few are found at the edges of the placenta, which are similar to those which earlier covered the whole chorion, but which, being in contact with the decidua reflexa, early atrophied. These are simply remnants or survivals, and if any use, are only for fixation of the placenta to the decidua.

2. Villi which are highly vascular, consisting of a stem and many branches which hang in the intervillous space bathed in maternal blood. These are covered with a layer of foetal epithelium. Earlier they have two layers, but as they grow, the epithelium is thinned out till the cells form a single layer. (See Fig. 7, p. 69.)

3. The most numerous villi are complicated branching structures with a thick stem and many branches, some of which pass on right through the intervillous space to end embedded in the maternal tissue of the decidua serotina. The attachment consists of heaped-up proliferated cells of epithelium covering the villi, and it is these embedded branches of villi which bring away with them the layer of decidua which comes away with the placenta. Where embedded, the villi lose their vascularity; but where in contact with blood in intervillous spaces they are vascular, and have a covering of a single layer of foetal epithelium.

Vascular relations.—In describing the development of the

placenta we noted the disintegration of the superficial layer of decidua and the proliferation of the endothelium of some of its vessels, causing their thrombosis. We noted that the intervillous blood space is extra-vascular in origin, being simply the space between chorion and decidua. Some villi cross it, others simply hang in it. Maternal blood gains access to it by the bursting of vessels in the decidua or by the phagocytic action of the foetal epithelium eating away the deciduate tissue that separates the maternal

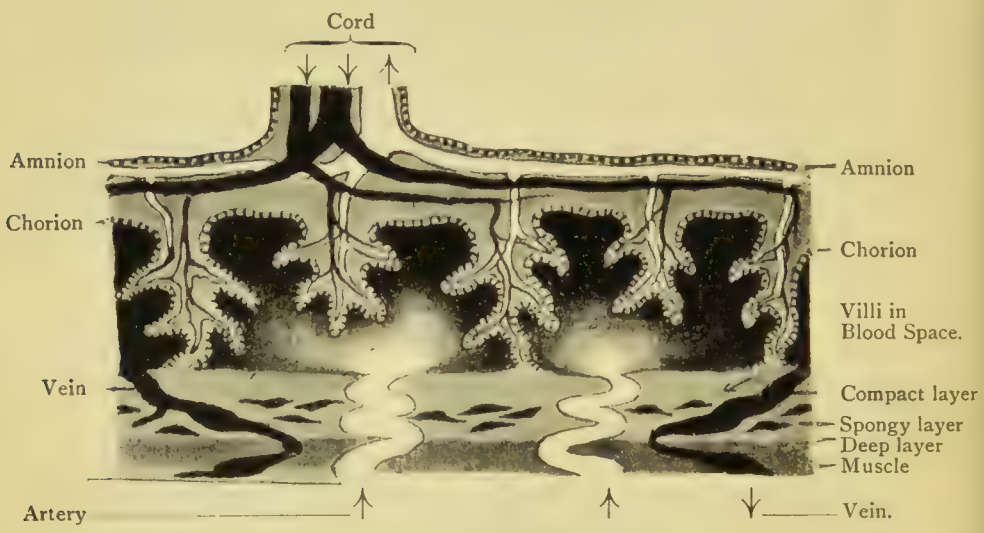


FIG. 8.—Diagram of placenta and its circulation.

vessels from the intervillous space. We also noted that there is between the maternal blood outside the villus and foetal blood inside the villus—(1) foetal epithelium; (2) foetal connective, and (3) endothelium lining foetal vessels —in fact, the elements of the villus.

Site of Placenta.—The placenta may be situated anywhere within the cavity of the body of the uterus. It is usually on the anterior or posterior wall, most frequently on the posterior. Rarely it is placed to one side, more often on the right. Occasionally it may occupy the fundus, which used to be considered its normal position. Post-

partum haemorrhage and inversion of the uterus are, however, more likely to occur when the placenta is at the fundus than when it occupies other positions. That part of the uterine wall within a radius of $2\frac{1}{2}$ to $3\frac{1}{2}$ inches from the os internum is passive during labour, is dilated and separated from the ovum during the first stage, and is known as the *lower-uterine-segment.* Now if the site of the placenta include a portion or the whole of this lower-uterine-segment, part of the placenta will be separated during the first stage of labour, and bleeding will inevitably occur. This dangerous condition is known as *Placenta Praevia*, and the bleeding attending it as *Inevitable Haemorrhage.*

Varieties.—Placentae with a very large site are apt to be thin, and may not separate easily during the third stage of labour. Those with a small site may be too small for the requirements of the foetus, and may cause abortion. A large placenta may extend beyond the decidua serotina on to the base of the decidua reflexa. Instead of being attached to the actual edge of the placenta, the membranes may come away from a circle some distance within its margin—*placenta marginata.* The placenta may consist of two, three, or more separate lobes—*bipartite, tripartite, or polydiscoid placenta.* There may be a space within the placental site devoid of villous tissue—*placenta fenestrata*, or one or more lobules of villi may be found outside the margin of the main structure—*placenta succinturiata.* In the placenta *velamentosa* the cord is inserted into the membranes, while in the "battledore" placenta it is attached to the margin of the organ itself.

A Simple View of the Placenta.

Before leaving the subject of the placenta we may glance at it once more from a new point of view, which will simplify the whole question. Every villus of the placenta consists of three elements — (1) *blood vessels*, (2) lowly

developed *connective tissue*, and (3) a covering of epithelium derived from the epiblast of the ovum—*foetal epithelium*. But the umbilical cord consists of exactly the same three

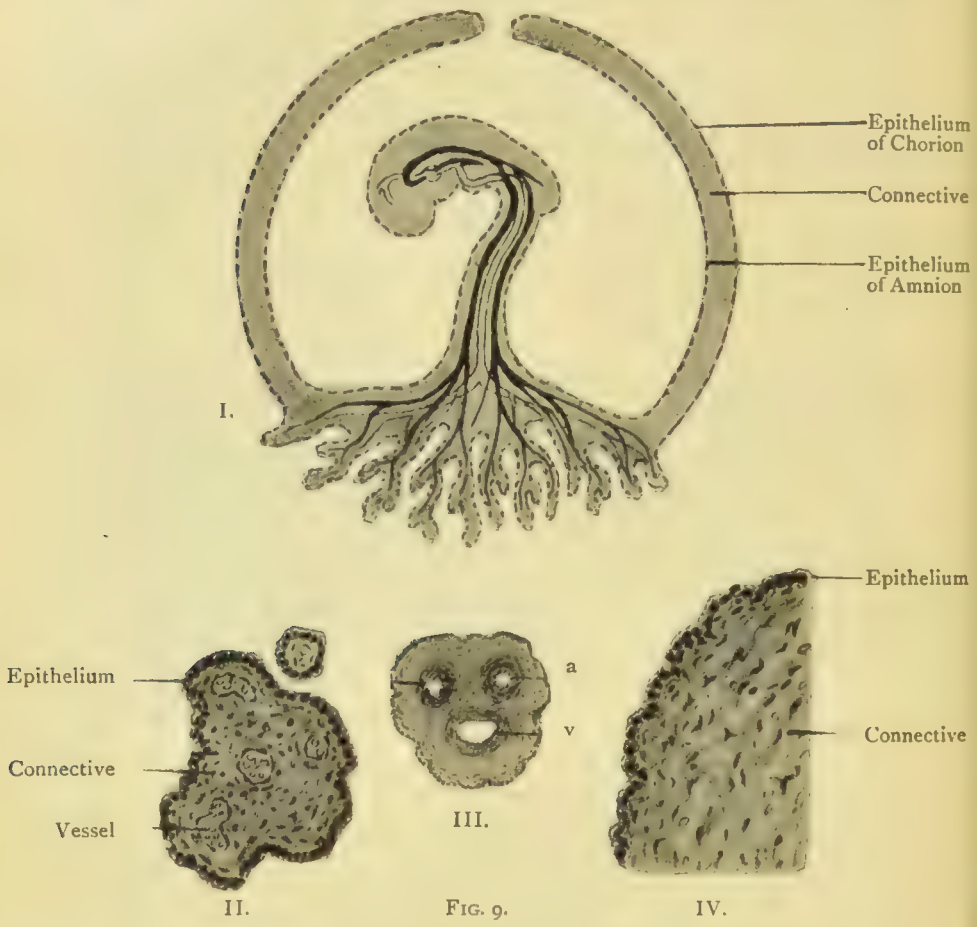


FIG. 9.

I. Diagram of a simple view of the ovum.
II. Section of a Villus, stem and branch. (High Power.)
III. Section of the Cord, twice natural size.
a = artery. v = vein.
IV. Margin of micro-section of Cord. (High Power.)
II., III. and IV. from nature.

elements—(1) *blood vessels*, (2) *low connective*—the Wharton's jelly—and (3) *foetal epithelium*. Now the *foetal portion of the placenta is simply the flattened out and enormously branched*

termination of the umbilical cord. In other words, the cord branches like a tree, every villus is a twig, and some of the twigs are attached to the decidua serotina, while maternal blood fills the spaces between the twigs.

The membranes can be included in this conception by considering them as a fold of the epithelium of the cord, expanded all round to form an envelope for the foetus. This envelope consists of two elements of the cord, as there is low connective tissue between the two layers of epithelium of the fold, but no blood vessels. This extreme simplification of the structure of the ovum is a purely anatomical conception and takes no account of the order of development, it should therefore be kept as a private mental picture, and not used when describing the development of the structures. (See sections of the cord and of a villus, and diagram, Fig. 9.)

The Foetus.

Rate of growth and development.—At the twelfth or fourteenth day, when the ovum is about $\frac{3}{8}$ in. in diameter, the embryo is about $\frac{1}{12}$ in. in length.

1st month.—The ovum is about the size of a pigeon's egg at the end of the fourth week. The whole chorion is villous. The embryo is about $\frac{1}{3}$ in. long; its limbs are beginning to appear, also the visceral arches. The cord is short and thick. The yolk sac is distinct, and the amnion is formed.

2nd month.—At the end of the second month the ovum is about the size of a hen's egg. The villi are now longer on one part of the chorion: the umbilical vesicle is relatively very small. The embryo is now about $\frac{3}{4}$ in. long. Ossification has commenced in the lower jaw. The primitive kidneys are being replaced by the permanent ones, and the reproductive organs are being formed.

3rd month.—At the end of the third month the ovum

is about the size of a goose egg—$3\frac{1}{2}$ to $4\frac{1}{2}$ in. long, villi having almost disappeared from all except the placental area. The embryo is 3 to $3\frac{1}{2}$ in. long. The intestine no longer protrudes into the cord; the external genitals begin to show differentiation of sex; nails become visible on the fingers and toes.

4th month.—At the end of the fourth month the foetus is 4 to $6\frac{1}{2}$ in. in length; its sex is easily seen. The lanugo or down begins to appear on the skin. The cord is now considerably twisted, and the placenta is largely increased in size.

5th month.—At the end of the fifth month the foetus averages $9\frac{1}{2}$ in. in length (7 to $10\frac{1}{2}$ in.). The skin is covered with the downy lanugo, and with vernix caseosa. This is a light-coloured, fatty substance, composed of the secretion of the sebaceous glands mixed with epidermal scales.

6th month.—At the end of the sixth month the foetus averages a foot in length (11 to $13\frac{1}{2}$ in.). There is hair on the eyebrows and eyelids, and the eyes are open.

7th month.—At the end of the seventh month the length of the foetus is about 15 in. One testis may have descended into the scrotum. The lanugo is beginning to disappear, and the pupillary membrane has disappeared.

8th month.—At the end of the eighth month the foetus measures 16 to 17 in. in length. There is still some lanugo. The nails do not reach the ends of the fingers and toes. The sebaceous glands in the nose are more plainly visible than later. The skin is still very red. Ossification is going on in the lower end of the femur.

9th month.—At the end of the ninth month the length is about 18 in., and the foetus is assuming the appearance of a full-time child. It still has some lanugo, the skin is red, the nails do not quite reach the ends of the digits, and the sebaceous glands in the nose are visible.

10th month.—**At full time** the child is about 20 in. long, but is often 21 in., and may be longer. There is long hair on the head. Both testes are usually in the

scrotum, and the labia majora are in contact. The nails project beyond the ends of the digits. There may be urine in the bladder, and the intestine contains meconium.

The foetus usually weighs from 6 to 8 lbs. Some are under 5 lbs., and a few are over 10 lbs. in weight. Cases are recorded in which the child at birth weighed 12, 16, and even 18 lbs. First-born children are usually a few ounces lighter than later ones. Male children are, on an average, $\frac{1}{12}$ heavier than females, and slightly longer. The relative ages and bulks of the parents have some effect on their children. The children are said to increase in weight as the mother advances towards the age of thirty or so; later they are said to become lighter but longer.

Foetal circulation.—Blood is not oxidised in the lungs of the foetus, the pulmonary circulation is therefore very small. For oxidation, the blood is sent to the placenta by the umbilical arteries, which are branches of the internal iliac arteries. From the placenta the purified blood is returned by the umbilical vein, which gives some branches to the liver of the foetus; but most of the pure blood passes through the liver by the *ductus venosus* into the *inferior vena cava*, and so reaches the *right auricle* of the foetus, mixed with impure blood from the liver and lower parts of the body. The stream of mixed blood from the inferior vena cava is directed across the *right auricle* by the *Eustachian valve*, and passes through the *foramen ovale* into the *left auricle*. Thence it enters the *left ventricle*, and so passes to the aorta of the foetus, and supplies first its head and upper extremities. The impure blood, entering the *right auricle* by the *superior vena cava*, passes into the *right ventricle*, and so into the *pulmonary artery*. Very little blood, however, enters the lungs of the foetus, as most of it passes on by the *ductus arteriosus* into the aorta, and, mingling with the already mixed blood flowing in that vessel, passes with it to the lower parts of the foetus, and to the placenta.

Early in foetal life the Eustachian valve is large, and almost prevents mixture, in the right auricle, of the purer blood entering it from the placenta by the inferior vena cava, and the impure blood entering it by the superior vena cava. Thus the head and upper part of the foetus are supplied by the purer blood, which passes through the

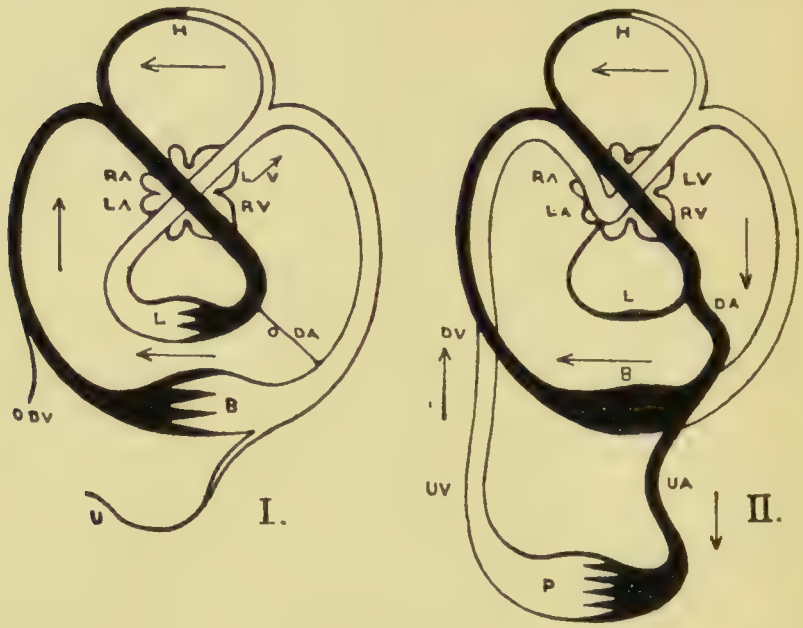


FIG. 10.—Schemes of Circulation.

I. After birth. II. Intra-uterine.

RA. Right auricle.
LA. Left auricle.
H. Head. B. Body.
UA. Umbilical artery.
DA. Ductus arteriosus.
ODA. Obliterated ductus arteriosus.
DV. Ductus venosus.
ODV. Obliterated ductus venosus.
U. To urachus.
RV. Right ventricle.
LV. Left ventricle.
L. Lung. P. Placenta.
UV. Umbilical vein.

foramen ovale into the left ventricle and aorta, while the lower parts of the foetus are supplied by the impure blood, which passes by the pulmonary artery and ductus arteriosus into the aorta. During the later months, the Eustachian valve separates the blood streams less completely, so that

more impure blood than formerly goes to the head, and more pure blood than formerly goes to the lower parts of the foetus. This accounts for the more rapid early growth of the head, which is made up for by the later acceleration of growth in the lower parts of the foetus.

Changes at birth.—At birth the pulmonary circulation of the foetus increases greatly as soon as the lungs are filled with air. The placental circulation is stopped completely. The ductus venosus, the umbilical arteries, and the ductus arteriosus now become obliterated and soon shrink into mere fibrous strands. The foramen ovale is closed by the rise of blood pressure in the left ventricle, and its opposed surfaces in a few days become permanently adherent. The foramen ovale may, however, take longer in closing, and occasionally remains permanently patent. Functionally, the circulation becomes the same as that of the adult as soon as the child breathes, and pulsation stops in the cord. If the whole ovum be born without rupture of the membranes, the foetal circulation may be made to continue for some time by immersing the ovum in warm water.

Nutrition.—Before the formation of the placenta the ovum is nourished by substances absorbed by the trophoblast and the chorionic villi. Once formed, the placental villi absorb from the maternal blood all the elements required for the growth of the foetus. The most diffusible substances are most easily transmitted from the maternal to the foetal circulation. Certain drugs, the microbes of various diseases or their toxic products, and minute particles of cinnabar have been shown to enter the foetal circulation through the placenta. The characters of the foetal blood are not altered by withdrawing blood from the maternal system. The foetal blood contains more corpuscles and more serum, but less fibrin and salts than other blood. The foetus may die of haemorrhage from the umbilical vessels, as when torn in cases of velamentous insertion of the cord.

This has no effect on the maternal circulation. Before the development of the liver and its assumption of functional activity, its glycogenic function is performed by other tissues. This function is important, as the foetal liver is relatively very large. The placenta is also said to have a glycogenic function.

Respiration.—The respiration of the foetus is accomplished by the exchange of gases in the placenta between the foetal and the maternal blood. Asphyxia is caused in a few minutes by compression of the funis during labour. The foetus can, however, be restored after prolonged asphyxia. The temperature of the foetus is slightly higher than that of the mother.

Secretion and Excretion.—The secretion of bile begins during the fourth or fifth month, the gall bladder begins to contain bile at about the seventh. Pepsin and trypsin may be detected from mid-term onwards; but no amylolytic ferment is produced until after birth. The intestinal mucosa secretes mucous, which, mixed with bile pigment, cholesterin and epithelial debris, forms the tarry meconium. Watery urine is sometimes found in the bladder at birth, and doubtless it is often discharged into the liquor amnii. The main excretion of urea is, however, performed by the placenta. This is proved by the fact that children have been born alive with no kidneys. Also there have been cases of impervious urethra where no distension of bladder or ureters has occurred, though cases of distended bladder show that the kidneys can at least sometimes act before birth.

Nervous System.—Movements are from time to time initiated by the nervous system of the foetus. They may all be reflex, but if so, the stimuli causing them are not known. Pressure on the cord, causing asphyxia, will induce them, as will changes in the maternal blood. The movements are also induced by palpation through the abdominal wall of the mother, by uterine contraction, and

by irritation of the skin of the foetus. Cerebrum and cerebellum are not essential for foetal life, for in their absence foetal movements and respiration occur. Foetuses born without medulla but with spinal cord cannot breathe, though movements of the limbs occur.

CHAPTER VI.

PREGNANCY—*Continued.*

Foetal Attitude.

The foetus in utero habitually has its back rounded, its head bent upon its breast, and its arms folded across the front of the body. The lower limbs are flexed at the hips and knees so that the heels approach the breech, the feet being dorsiflexed, and the soles turned inward. The legs, like the forearms, are usually crossed.

Presentation and Position.

During pregnancy it is possible to palpate the "presenting" part of the foetus per vaginam through the uterine wall, and by abdominal palpation it is usually easy to ascertain if the long axis of the foetus coincides with the long axis of the uterus, and whether the head or the breech occupies the lower pole of the uterus. It can also be ascertained whether the back of the child lies to the right or to the left of the mother, so that it can be determined whether the "presentation" is a "head" or a "breech," and as to "position" some knowledge can be gained. If the long axis of the child lies across that of the uterus, the presentation is "transverse," and a shoulder will occupy the lower pole of the uterus. During labour the presenting part can be clearly felt through the dilated cervix, and its "position" or relation to the pelvis can be accurately determined. The farther pregnancy advances, the less easily can the foetus change its presentation. In multiparæ changes

are frequently noted till just before labour begins. In primiparæ changes are rare during the last month.

Frequency.—At the end of pregnancy the frequency of head presentations is about 26 to 1. Breech presentations are about 1 in 32, and transverse presentations about 1 in 200.

Causes.—It is natural that the long axis of the foetus should coincide with the long axis of the uterus, and this explains the rarity of transverse presentations. It is less easy to understand why presentation of the head should be so much more frequent than that of the breech. This frequency of head presentations has been explained by gravitation. The head of the foetus being relatively heavy, it is said to float low either in liquor amnii in utero, or in fluid after removal from the uterus. The shape of the foetus and of the uterine cavity are also said to favour head presentation. Late in pregnancy the lower pole of the uterus is narrow and well fits the foetal head, while its upper portion is broader and more suited to the reception of the foetal body and limbs. It is further said that the foetus makes reflex movements in response to the pressure on its surface of the uterine walls, and so moves itself into the position in which it best fits the uterine cavity. In this position there is the least pressure on the foetus—the least stimulus to movement—so that it tends to retain the position when once it is gained. Other factors tending to preserve a good position are the tonicity of the uterine muscle, and that of the body of a living foetus.

The causes of breech and transverse presentations are various circumstances which interfere with the action of these causes of head presentation. It is therefore sufficient to enumerate the classes of cases in which irregular presentations are most frequently found.

1. Premature labour, in which the foetus is small and the quantity of liquor amnii is relatively large.
2. Death of the foetus, by which its tonicity is lost.

3. Changes in form of the foetus due to disease, *e.g.*, *Hydrocephalus.*

4. Malformations and monstrosities.

5. Twins and triplets.

6. *Hydramnios.*

7. Irregular contractions of the uterine wall and disease of same, *e.g.*, *Fibroid.*

8. Maternal tumours complicating pregnancy.

9. *Placenta Praevia.*

10. Congenital malformation of the uterus.

11. Accident or mechanical interference before labour.

Multiple Pregnancy.

Twins.

Frequency.—In Britain the frequency of twin pregnancy is variously estimated at from one case in ninety to one case in one hundred and ten. In Germany it is said to occur once in eighty-four cases; in Belgium once in ninety, and in Ireland once in sixty. It may be stated that, on the average, twin pregnancy occurs once in eighty cases.

Causes.—It is obvious that plural gestation is commoner amongst some races than in others. To racial must be added family peculiarity, as twins have frequently been shown to occur repeatedly in the same family. This might also be expressed by saying that the tendency to bear twins is an individual peculiarity transmissible by heredity. There is some evidence to the effect that the paternal element may have some effect in the causation of twins; as the same man is often the father of twins by different women, and brothers have frequently been the fathers of twins by women in no way related to one another. Twins are commonest in the first pregnancy, and are more frequent in old than in young primiparae. Apart from the first, their frequency increases with successive pregnancies. Twins are common in those families which produce im-

beciles and idiots, and also in those where bodily deformities like club-foot and spina bifida occur. Multiple pregnancy is said to be very frequent in connection with ectopic gestation, one ovum in a tube and one in the uterus being the usual arrangement in these cases.

Varieties.—Twins are either *binovular*, in which case each is developed from a separate ovum, or *uniovular*, when both foetuses are formed from a single ovum.

1. **Binovular.**—Binovular twins, then, result from the development of two ova. There may be a corpus luteum in each ovary, showing that the two ova concerned may be derived one from each ovary. There may be two corpora lutea in the same ovary, showing that the two ova may be derived from two ovisacs in one ovary. Lastly, there may be only one corpus luteum, which shows that two ova may be derived from one ovisac.

The two ova may be fertilised at one coitus, or at two different times. That the latter can occur is proved by the fact that a woman has been delivered of binovular twins, one of which was black and the other white, the two ova having been fertilised by black and white fathers respectively. This fertilisation of two ova during the same intermenstrual period, but at different times, has been termed *superfecundation.* The fertilisation of two ova at different times during different intermenstrual periods is said to have occurred, and has been called *superfoetation.*

Two ova have been found developing one in each side of a double uterus; one in the uterus and one in a Fallopian tube; and one in each Fallopian tube.[1]

When both ova are in the body of the uterus they may or may not be enclosed at first in a single decidua reflexa. Whether the reflexa has been single or double is not apparent at the end of pregnancy.

Each ovum has, of course, a complete and separate chorion at first, and these may remain complete and

[1] Walter, Brit. Med. Journ., Oct. 1, 1892.

separate till the end of pregnancy. The contiguous portions of the two chorions may, however, fuse as pregnancy advances, and the fused portions may disappear, so that at birth the two foetuses, *though binovular*, may seem to have developed in a single chorionic sac.

Each foetus is provided with a distinct amnion, and the two amniotic sacs remain separate throughout pregnancy, except, possibly, in extremely rare cases. Binovular twins are thus found at labour in distinct sacs of fluid, separated by two layers of amnion, if not also by two layers of chorion.

Each foetus has, of course, a separate placenta, and though the two placentae may touch one another, there is no communication between their respective blood vessels.

Binovular twins may be considered as physiological. They frequently occur in multiparae, and near the middle of reproductive life. They are six times as common as the uniovular variety. The children are often carried to full term, and are fairly large and healthy. Their sex may be the same, but is very frequently different.

2. **Uniovular.**—Uniovular twins result from the development of a single ovum. This ovum may have two blastoderms, each developing separately; or it may have a single blastoderm, which divides into two portions, each producing a foetus. The single ovum has, of course, a single reflexa and a single chorion. Both foetuses may be enclosed in a single amnion, or each may have an amniotic sac of its own. Thus it happens that at birth the twins, *though uniovular*, are often contained in two distinct sacs of fluid, separated by two layers of amnion, but never by layers of chorion. Ahlfeld states that only .8 per cent. of twins are found in a single amniotic cavity.

The foetuses are attached to a single placental mass. Their cords entering it separately, or sometimes uniting, to be inserted into the placenta. There is almost always more or less communication in the placenta between the two foetal circulations.

Uniovular twins must be considered as pathological. They occur at the beginning and at the end of reproductive life. They perish prematurely three times as often as the binovular variety, and, when carried to full term, are light, feeble and unhealthy. They are always of the same sex. Malformations are common. Their frequency is estimated variously at 1 in 5, 1 in 6, and 1 in 8 of all twin cases.

When one embryo is less developed than the other, the heart of the stronger embryo may so overpower that of the weaker that blood is forced from the single placenta up the umbilical arteries of the weaker embryo. This disturbs its

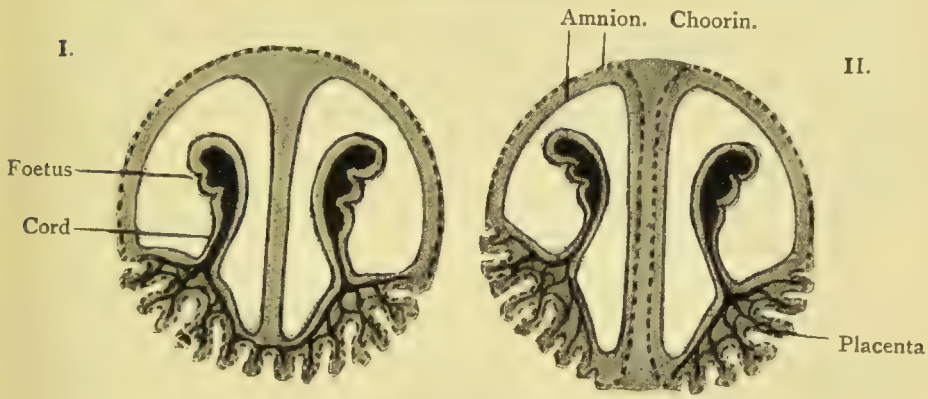


FIG. 11.—Diagram of Multiple Pregnancy.
I. Uniovular Twins.
II. Binovular Twins.

foetal circulation, and causes atrophy of its heart. The lower portions of the weaker embryo, being nourished by blood pumped into them by the umbilical arteries, develope at the expense of the upper portions of its body, which cease to be properly nourished by pure blood brought by its umbilical vein. The heart and upper parts of the foetus thus are often reduced to a mass of tissue not differentiated into organs, the lower limbs only being recognisable as such. This gives origin to the *acardiac monster*. Incomplete division of a single blastoderm produces the various forms of *double monster*.

Course.—Twin pregnancy is said to end prematurely in 66 per cent. of cases. One embryo may die and be expelled, the other going on to full time. Instead of being expelled, the dead embryo may be retained and become shrunken and flattened by the pressure of the growing ovum, to be found at delivery a so-called *papyraceous* foetus. Hydramnios is common, as also is the vesicular degeneration of the chorion known as *hydatid mole.* Albuminuria is a frequent complication. Placental disease, faulty development of the cord, crossing and twisting of the cords are common causes of twin mortality. The two foetuses are usually unequal in size. The weight of a single one at birth is from 3 to 7 lbs., the average weight of the pair being about 9½ lbs. In 64 per cent. twins are said to be of the same sex—these being all the uniovular cases and some of the binovular. Of those of the same sex, 52 per cent. are male, and 48 per cent. female. In after life twins are not less fertile than other people.

Diagnosis.—The presence of twins is not usually recognised till one foetus is born. It may be noted that the abdominal tumour is large, and it may be seen to be traversed by a groove. It may be possible to palpate two heads, and an unusual number of foetal parts. If two foetal hearts can be heard with their maximum intensity at different points and differing in pulse rate, twins can be definitely diagnosed. On examination per vaginam the distance from os to fundus may be recognised as larger than usual.

Presentation.—Twins may lie in utero in any of the positions logically possible. The relative frequency of these is stated as follows from their presentations on delivery:—Both heads, 49 per cent. Head and Breech, 31.7 per cent. Both Breeches, 8.6 per cent. Head and Transverse, 6.18 per cent. Breech and Transverse, 4.04 per cent. Both Transverse, .35 per cent.

Triplets.—Triple pregnancy is said to occur once in from 6000 to 10,000 cases. Quadruplets occur once in 385,000

cases. There are no authentic cases of more than five at a birth. Triplets may arise from three separate ova; two from one ovum and one from another; or three from one ovum, the membranes and placentae being arranged accordingly.

Superfoetation.—The fertilisation of two ova shed during different menstrual periods at two separate acts of coitus has been called superfoetation. The fertilisation of ova shed during the same menstrual period at two separate acts of coitus is known as superfecundation. While superfecundation is doubtless a common origin of binovular twins, the occurrence of superfoetation in a normal uterus is doubted.

For superfoetation to occur it is necessary to allow that ovulation can occur during pregnancy, and that the mucous plug which usually closes the cervical canal early in pregnancy may sometimes fail to do so. After the third month the reflexa fuses with the vera obliterating the uterine cavity. This obliteration being completed, superfoetation could not occur.

Twins show so frequently very unequal development that the existence of this is no proof of superfoetation. A woman has had two apparently full-time children, one about four months after the other. Given ovulation during pregnancy, and granted that the first child was premature, it is possible that the second might have been fertilised just before the union of reflexa and vera, and so have arrived at full time four months after the birth of the first. Another explanation of the circumstances has been based on the statement that the ova of certain deer are fertilised in August but do not begin to segment till December. In a case of tubal pregnancy, a five months' foetus was found in the tube and a three months' ovum in the uterus. In this case the uterine cavity would be perfectly accessible to ova from the other tube, and to spermatozoa from the vagina. Similarly it is easy, given ovulation during pregnancy, to understand superfoetation in a double uterus (see page 132).

For pregnancy can advance in one side or horn of such a uterus, leaving the other patent. Where pregnancy in a double uterus ends naturally, the presence of the malformation is seldom detected, and it may well be that most, if not all, the recorded cases of superfoetation have occurred in double uteri.

Period of Gestation.

Average.—The average duration of gestation is, in legal and popular opinion, 280 days ; 40 weeks ; 10 lunar months or ordinary menstrual periods ; 9 calendar months.

This average has been arrived at by various data of calculation. Counting the days from a stated **single coitus** to the date of birth in 518 cases, Loewenhardt found the average 272.2 days. Hasler found the average to be 272.24 days in a large number of cases. Hecker's average was 273.5 ; Duncan's 275.

Counting the days from **date of marriage** to date of labour in 67 cases, an average of 272 days was obtained (Leuchardt). Counting from the end of the **last menstruation**, an average of 278 days is obtained (Duncan and others).

Considering that conception occurs most frequently a few days after menstruation has ceased, it may be stated that **273 days** is, so far as can be ascertained, the average duration of pregnancy. Remembering that coitus some days before or after ovulation may result in fertilisation, and that ovum and spermatozoon may not meet for days after coitus, it is clear that no figures can give anything but a rough average. Nor is there any reason to believe that, could we ascertain the actual duration of pregnancy, it would be found to be always the same. It probably varies within somewhat wide limits. Some women are found to have habitually a long or a short gestation. The period is thought to be short early and late, and long in the mid-portion of reproductive life: it is also shorter in single than in married women. It is highly probable that a woman's period of gestation varies with the length of her menstrual cycle.

Short.—The expulsion of a foetus not capable of living outside the uterus is termed abortion or miscarriage; while the expulsion of a foetus so far advanced in development that it may survive is called premature labour. A child capable of surviving is called viable, and some interest attaches to the length of time after conception at which such may be born. This is, in the eye of the law, six calendar months; but this is probably too short a period for the development of a viable child. The end of the 7th lunar month or menstrual period is a more probable time for the birth of the youngest viable children. Professor A. R. Simpson describes twins, together weighing 6 lbs. 7 oz., which were born on the 207th day; and also a woman who, married in March, menstruated from April 14th to 17th, and was delivered of a child 14 inches long on November 14th—*i.e.*, in 207 days. A few cases such as these are genuine: but most supposed short gestations are unfounded. In cases of affiliation it is often urged for the defence that the date of coitus is not sufficiently remote from the date of birth of a viable child. In the case of a minister who was charged, before an ecclesiastical court, with antenuptial intercourse, it was decided that the offence had not been committed on the production of a letter from the lady bearing a date and proposing to postpone the marriage.

Long.—Many cases of protracted gestation are recorded, most of them being calculated from a single coitus or from death or absence of the husband. Sir J. Y. Simpson's case of 313 days duration of pregnancy and Professor A. R. Simpson's of 308 days are perhaps the longest that are well established. They are probably to be explained like similar cases in which pains have come on at the end of the 10th menstrual month as usual, but have passed off not to return till four weeks later, at the end of the 11th menstrual month, when a large heavy child has been born. The law of various countries allows the legitimacy of children born within about 300 days of the death or absence

of the father.[1] A child born after a supposed gestation of 317 days has been held legitimate in America. In a case in which the father and mother separated, a child born 304 days later was decided to be legitimate on non-medical evidence in this country. The question of protracted gestation is also important in affiliation cases.

Calculation of the Probable Date of Labour.

As the duration of pregnancy varies so considerably, and as it is impossible to ascertain the date of its commencement, it is useless to spend much trouble in calculating the probable date of labour.

Menstruation.—When a woman is menstruating regularly before pregnancy, it is usual to base the calculation upon the date of the last menstruation. The *first* day of the menstrual period is usually that noted or remembered, so it is convenient to calculate from the date of the commencement of the last menstruation. Allowing three or four days for menstruation, and also allowing three or four days to pass after the end of menstruation before conception occurs, we may add 7 days to the 273 days average duration of pregnancy, giving 280 days from the commencement of the last menstruation as the probable date of confinement. Roughly this may be calculated by taking the date of the *first* day of last menstruation, going forward a week from this date, and then going forward nine calendar months (or backward three calendar months). It is equally convenient to simply go nine months forward or three backward from the *last* day of the last menstruation.

[1] English law affixes no definite limit to gestation. In Scotland a child is not considered a bastard unless born more than 10 calendar months after death or departure of mother's husband. In France the legitimacy of children born within 300 days is not questioned; if born after 300th day, legitimacy may be contested, but bastardy is not declared.

TABLE FOR CALCULATING PROBABLE DATE OF LABOUR.

Nine Calendar Months.			Ten Lunar Months.	
From	To	Days.	To	Days.
January 1	September 30	273	October 7	280
February 1	October 31	273	November 7	280
March 1	November 30	275	December 5	280
April 1	December 31	275	January 5	280
May 1	January 31	276	February 4	280
June 1	February 28	273	March 7	280
July 1	March 31	274	April 6	280
August 1	April 30	273	May 7	280
September 1	May 31	273	June 7	280
October 1	June 30	273	July 7	280
November 1	July 31	273	August 7	280
December 1	August 31	274	September 6	280

A woman, however, frequently does not know the date of her last menstruation. And in the case of the newly married there has frequently been no menstruation since marriage. Pregnancy may occur during periods of amenorrhoea. Menstruation may occur for a month or two at the beginning of pregnancy, and may be simulated in spite of pregnancy by various sanguineous discharges. There are thus many cases in which it is necessary to calculate the probable date of confinement upon data other than menstruation.

Coitus.—If there be a single coitus of known date from which to calculate, it is easy to go forward 273 days from that date.

Quickening. — The alleged date of "quickening" is practically of no use for calculation, though it may be helpful when noted by an intelligent multipara. It is usually felt between the 17th and 20th weeks; and, remembering that it should occur at about mid-term, any discrepancy between the date of quickening and that of the last menstruation will be noted, and will suggest an examination of the patient.

Height of Fundus.—The height of the fundus relative to the abdominal wall is an important guide. During the first three months the fundus cannot be felt above the pubes. During the next three months it rises just past the umbilicus, and during the last three months it rises to within 1½ inches of the ensiform cartilage.

Length of Foetus in Utero.—The length of the foetus as it lies curled up in utero is found to be about one inch for every lunar month of pregnancy that has passed. The length of the foetus in utero is much the same as the distance from the pubes to the fundus. This distance is best measured with callipers, placing one knob on the upper margin of the pubes and the other on the fundus. The distance in inches then gives the number of lunar months that have passed. If no callipers are at hand a tape measure may be used, remembering that in the 7th, 8th, and 9th months the tape measurement is about 3 inches greater than that taken with callipers.

If greater accuracy of measurement be desired, one knob of the callipers may be put in the vagina and held against the uterine wall over the presenting part of the foetus, while the other knob is applied to the fundus. This should be done in cases where the head is above the brim, and when considering the induction of premature labour. The measurements given by Sutugin are as follows:—

Lunar month.	Foetus in utero.
7th.	7.6 inches.
8th.	8.3 ,,
9th.	9.2 ,,
10th.	9.7 ,,

Causes of Parturition.

While it is clear that pregnancy varies in duration within limits, it is equally clear that it normally ends in parturition after a certain fairly definite time. It is necessary to explain

this, and many theories have been constructed with this object. It is at menstrual periods that the nervous mechanism of the uterus is most irritable. During pregnancy the irritability of the nervous system gradually increases, and is heightened at each epoch corresponding to a menstrual period. The menstrual cycle in fact continues throughout pregnancy, although the menstrual discharge is in abeyance. This is evidenced by the sensations of malaise which many women experience at the epochs during pregnancy corresponding to menstrual periods. Abortions usually occur at these times, and also premature labours. Causes may operate which are sufficient to produce expulsion of the ovum at times between these cyclic periods; but abortion or premature labour at a time corresponding to menstruation is produced by causes smaller than those necessary at other times. In ectopic gestation the decidua formed in the uterine cavity is usually expelled at such a time, and where, in utero-gestation, death of the foetus occurs, the dead foetus is not usually expelled at once, but lies in utero, to be expelled at the end of the menstrual cycle. It may therefore be stated that parturition tends to occur at a period corresponding to a menstruation, and it may be added that the reason for this is the heightened irritability of the nervous mechanism at these periods.

But observation informs us further that labour tends to occur at that period which is about 40 weeks from the last actual menstruation, that is, when 10 menstrual cycles have been passed without menstrual discharge. The question thus comes to be: Why should labour occur at the end of the 10th menstrual cycle, rather than at the end of the 9th or of the 11th?

The answer to this question is not to be found in any peculiarity of the child at this date. For children can survive if born earlier or later than at this particular time. Nor is the point explained by the occurrence of fatty degeneration in the deciduae towards the end of pregnancy,

causing the ovum to act as a foreign body. For a dead ovum may often be long retained in utero, and in many cases of multiple pregnancy a dead ovum is retained for months in utero while its fellow continues to develop. The degree of distention of the uterus by a full-term ovum has also been suggested as the cause of parturition. But in cases of hydramnios and of twins much greater distension is often present before full time without causing labour. Again, in tubal pregnancy, labour is attempted at the usual time, although the empty uterus is not distended at all. Another explanation has been found in the statement that during the last month of pregnancy proliferation of the endothelium of the vessels in the decidua serotina causes thrombosis of some of them, and so brings on labour by a disturbance of circulation. But Hart and Gulland and Webster find this proliferation and thrombosis going on as early as the second month of pregnancy. These explanations, therefore, do not show why labour should tend to occur at the end of the tenth menstrual cycle, rather than at the end of the ninth or the eleventh.

The principle of natural selection, however, helps to a solution of the question. For it is clear that children born at the end of the ninth cycle or earlier cannot well compete in the struggle for existence with those born later. In other words, full-time children survive more frequently than premature ones. This was doubtless equally true at that remote period when the ancestors of the human race had as yet no definite gestation period.

On the other hand, dangers attend those children that are carried till the end of the eleventh cycle, for by this time they are so large that parturition has increased risks to the life of both mother and child.

The influence of heredity in transmitting these variations must next be considered. Some children die through having been born too early; some, carried too long, are too large to be born alive; and some mothers die in

attempting the birth of children carried too long. These are obviously unable to transmit to posterity the tendency to short or long gestation. Those, however, who survive, inherit from their parents, and hand on to their offspring, the tendency to have a gestation period similar to their own.

Now, as the majority of survivors are those born at the end of the tenth menstrual cycle, heredity increases this majority till its habitual gestation period of ten menstrual cycles becomes typical of the human race.

Hygiene of Pregnancy.

It must be remembered that labouring women have the easiest confinements, and that parturition is a great and prolonged effort of the muscular, circulatory, and nervous systems, for which preparation may be made by training, just as for any feat of strength and endurance. The pregnant woman should, therefore, be as much as possible in the open air, should observe regular habits, should avoid late hours, crowded rooms, and excesses of all kinds, and should have plenty of sleep. She should take as much exercise as possible, but this should be of suitable kinds, walking probably being the most useful in this as in other training. The diet should be plain and nutritious, and only just the necessary amount of food should be taken. There is much greater danger of eating too much than too little. Alcoholic drinks should be avoided. Constipation must be prevented. The clothing should be warm and light. Stays should be discarded, or, if worn, should be elastic. Garters, if worn, should be above the knee. The lower limbs should be carefully clothed, as the skirts hang away from them in the later months. An abdominal belt or a binder may be worn to support the growing uterine tumour. The breasts may need to be supported by a suitable bandage, and the nipples may demand careful attention. They must not be pressed in by the clothing, and if already

flattened they should be gently encouraged to protrude by manipulation, by placing an elastic ring round their base for a few minutes every day, or by wearing nipple shields. The nipples may be hardened by bathing with spirit and water or a solution of any astringent, but this should not be done too much, as hard skin cracks easily. The tendency to cracking is met by greasy applications, lanoline being specially useful. Baths may be taken freely, and the vagina may be douched if there is leucorrhoeal discharge; but neither the bath nor the vaginal douche should be hot or cold, but warm. Caution should be observed at times corresponding to menstrual periods. Coitus often causes abortion, especially during the first four months. The urine should be tested for albumen during the later months.

The above refers to women whose health is not much affected by pregnancy, but in many cases it may be necessary to add many precautions. Where there is any tendency to abortion, exercise must be carefully regulated, as slight exertion has often caused it, though some women can ride and dance during pregnancy. Driving may be substituted for walking under some circumstances, and it may be necessary to confine this to smooth roads. Emotional disturbances must be avoided in cases where mental irritability is increased during pregnancy. It may be necessary in cases of disturbance of digestion to give food frequently in small quantities.

CHAPTER VII.

PATHOLOGY OF PREGNANCY.

DISEASE IN THE MOTHER.

Epidemics.

Pregnancy has been said to give immunity from prevalent diseases. This is not so, and during the puerperium women are more than usually susceptible to the attacks of infective disease. This is because they have frequently lost blood during labour, and because the raw surface in the cavity of the uterus provides a nidus for the growth of pathogenic organisms from which their toxic products are most easily absorbed. This explains the fact that when an acute infective disease attacks a pregnant woman, premature expulsion of the ovum exposes the patient to increased danger from the disease.

Influenza.—Menorrhagia often accompanies this in the non-gravid, and it has caused precipitate labour with post-partum haemorrhage. It is said to cause abortion but rarely.

Cholera.—The cramps often induce labour, apart from the virulence of the disease. They often kill the foetus, and haemorrhage into the uterus frequently occurs. Abortion is often forestalled by the early death of the mother. Out of 52 cases, 25 aborted, and 16 of these recovered; while 27 did not abort, and only 6 of these recovered.

Typhoid.—63 per cent. of cases show abortion or premature labour, a temperature of 104 degs. F. being usually

fatal to the foetus. Haemorrhage is common. Pregnancy is said to mitigate the disease, while the puerperal state aggravates it, so that the occurrence of premature labour has an unfavourable effect upon the prognosis.

Typhus.—This is rarely seen in connection with pregnancy. It runs a somewhat independent course, and is said to be less likely to interrupt pregnancy than similar diseases.

Relapsing Fever.—This is said to cause interruption of gestation, but varying statements are made.

Small-pox.—Pregnancy gives no immunity from this any more than from other diseases, so pregnancy does not contra-indicate vaccination. Uterine haemorrhage often occurs, causing abortion. The high temperature often kills the child, which, however, may be born healthy or with small-pox—one of twins may have the disease, the other escaping. The child usually resists vaccination. It is possible for the child to have the disease, the mother escaping; and it may develope small-pox after birth, though it be three months since the mother recovered from the disease. Vaccination should not be done during the puerperium, when all introduction of septic matter to the system should be avoided.

Scarlatina.—This, if bad, may cause abortion, which makes the prognosis worse. Pregnancy seems to prolong the incubation period, but this may be because germs remaining about a house may attack the patient only when she reaches the puerperal state,—a very dangerous accident. The child may have the disease and recover, its skin peeling off before, at, or after birth.

Acute Lobar Pneumonia.—This often interrupts gestation, and thus impairs the prognosis, as a virulent form of puerperal fever is likely to occur. Labour should be postponed as long as possible, but when inevitable it should be hastened. High temperature is often the cause of death of the foetus.

Measles.—50 per cent. of abortions are said to occur. Haemorrhage is common. The child may have the disease in utero or after birth.

Erysipelas.—Abortion in this disease may be followed by a bad form of puerperal fever, with local manifestations.

Diphtheria.—This also is liable to attack the genital passages after labour, a membrane forming over the vaginal and uterine surfaces.

Malaria.—Pregnancy mitigates or changes the periodicity of attacks. Patients with latent malaria are often attacked during the puerperium. Abortion may be caused.

TUBERCULOSIS.

Pregnancy has been said to ward off attacks of tuberculous disease; but this is not true in general. Though phthisical patients who become pregnant may seem better for a time, the progress of the disease is not arrested, and it advances rapidly during the puerperium and lactation. In those with only a predisposition to phthisis, the strain of pregnancy offers a favourable opportunity for the initial attack of the bacillus, though no lesion may be discovered till gestation is over. It is only advanced pulmonary phthisis that will cause abortion or premature labour. Some cases of early hip-joint disease cause a contraction of the pelvis that interferes with labour, and the kyphotic pelvis is a well-marked result of caries of the lumbar vertebrae.

Marriage.—Women with tubercular disease should not marry for the following reasons:—1st, risk of shortening their own life, and of preventing possible recovery from the disease in early stages; 2nd, probability of communicating the disease to the husband; 3rd, risk of bearing children predisposed to the disease, and very likely to receive it by infection from their mother. Mothers with tuberculous

disease should not nurse, because (1) lactation is an additional strain, and (2) the mother may very easily convey infection to her children. Men with tubercular disease should avoid marriage for similar reasons, and, if fathers, should use great care to avoid infecting their children.

Treatment.—When a tuberculous patient is pregnant it is not as a rule necessary to procure abortion or premature labour, but when labour begins it should be ended quickly by early assistance from the accoucheur.

Syphilis.

Pregnancy aggravates the primary symptoms of syphilis, but tends to lessen subsequent ones. The disease affects pregnancy as follows :—

1. When a woman contracts syphilis after pregnancy has begun there will be great local manifestations affecting vagina, vulva, nates, and the inner sides of the thighs. There may be abscesses and extensive sloughing. If the infection be received early in pregnancy the child will contract the disease ; but if the mother be infected during the later months the child may escape ; though in this case it is very likely to be infected as it passes through the genital canal at parturition.

2. When a woman contracts syphilis at the time of fertile intercourse, the pregnancy usually ends in abortion. If gestation proceed, the child may have syphilis at birth, or may soon develope it, if it live long enough. The mother has aggravated primary symptoms.

3. When an already syphilitic woman becomes pregnant, early abortion usually occurs, and is usually followed by a series of other abortions, each a little later than the last.

In these three cases the father usually has syphilis in a stage in which it can be directly transmitted to the mother. By far the commonest case we have yet to consider.

4. When the father has had syphilis, it may be ten years

previously, the mother has no primary sore and does not contract the disease from the father, who may have tertiary symptoms or none at all. The mother, however, will probably abort time after time, the disease being transmitted from the father to the child, and so to the mother. She may show no symptom of syphilis, and it may only be the repeated abortions that suggest its presence. She may, however, have secondary symptoms, such as eruptions, sore throat, and falling out of the hair. It may be that a new infection being communicated with each pregnancy, abortion occurs earlier and earlier each time. Usually, however, each pregnancy lasts longer than the one before it, till at last a child is carried to term and born alive. Such a child may be syphilitic at birth, or may develope the disease in a few weeks. The point is, however, that if the child is nursed by a non-syphilitic woman it will infect her; while if nursed by the mother it will not infect her. This shows that the mother, though she has no symptom, has either syphilis itself, or at least immunity from it. This fact, known as Colles' law, that a woman cannot receive syphilis from her own syphilitic child, is, in many cases, the only proof that she has been affected by the disease. Such a woman may later bear healthy children that grow up without developing any syphilitic symptoms.

Marriage.—A man who has had syphilis must not marry (1) till he has undergone a course of mercurial treatment; (2) till three or four years have elapsed from the time of his infection; (3) and till he has remained free from symptoms for one and a half or two years. Cerebral symptoms should always prevent marriage.

Treatment.—When it is ascertained by examination of the foetus, or in any other way, that an abortion has been due to syphilis, both father and mother must undergo a course of mercurial treatment. Conception should not be allowed to occur again until this has been done, and until both have been quite free from symptoms for

some months. When the woman again becomes pregnant, which should not occur till from two to three years after her abortion, she must be given some iron, and the blood must be kept alkaline right up to the end of pregnancy by the administration of small doses of potassium chlorate so frequently that the system is never free from the salt. If premature labour follow, or the child develope specific symptoms, the whole process must be repeated. No regard must be paid to paternal statements as to the remoteness of the original infection or as to the completeness of its cure. When a living child is obtained the mother must nurse it herself, as it will not hurt her, while it would infect a wet-nurse, giving her a primary hard sore on the nipple. If the child show any specific symptoms it must be treated by mercurial inunction. This can conveniently be done by placing under the child's flannel binder every day a piece of mercurial ointment about the size of a pea.

Before giving a course of anti-syphilitic treatment the mouth should be put in good order. Decayed teeth should be filled or extracted, and borax or potassium chlorate used in washes for the cure of any sore places. A physiological life must be enjoined, free from alcoholic or other excesses, and from over-work. Iron must be given if the patient be chlorotic; potassium iodide may be used with advantage in the later stages; but mercury is the essential drug. A very effective method is to prescribe Hydrargyrum cum Creta, gr. $\frac{1}{2}$; Ferri Sulphas, gr. $\frac{1}{2}$—in a pill. Patients can take these pills freely without causing diarrhoea. Having obtained a gross or two of them, the patient takes three the first day (at separate times); four the third day; five the fifth day, and so on, adding a pill every other day till there is some evidence that the drug is exerting its full physiological effect. The consciousness of having teeth, looseness of teeth, slight salivation or a slight metallic taste in the mouth, are signs that the limit has been reached.

Suppose the patient is now taking twelve pills a day. Let him stop altogether till all symptoms of mercurialism disappear, and then begin taking steadily six pills daily. In other words, let the patient take steadily half the dose he had arrived at when salivation appeared. With intervals this treatment may be continued for a year or more. The Liquor Hydrargyri Perchloridi may be given, and if it is desired to exhibit potassium iodide, it is convenient to use this preparation. For taking Liq. Hydr. Perchlor., ℥vi, and Pot. Iod., ʒi, there will be sufficient pot. iodide present to re-dissolve the iodide of mercury formed, and ʒi of this fluid, thrice daily, may be taken for a long time. When pregnancy is allowed to occur again, mother and father having ended their mercurial course, and having been free from all symptoms for some months, the following mixture will be found a good form in which to give the woman her potassium chlorate:—℞. Pot. Chlor., ʒii; Tr. Ferri Perchlor., ʒii; Glycerini, ℥i; Aquam ad ℥vi. Sig. ℥ss. ter in die.

Nervous System.

Insanity.—Mental derangement is commoner during the puerperium than in pregnancy. It usually takes the form of melancholia, but mania is not rare. Much commoner during pregnancy are minor symptoms, perverted tastes and cravings, and depravities like dipsomania and kleptomania. Recovery before labour is rare, after labour it is usual; but puerperal insanity may follow. A sudden attack of mania during delivery is a much less serious occurrence. Child murder under such circumstances is looked on leniently by the law. Mental symptoms are but a bad indication for the induction of premature labour, as the proceedings are likely to aggravate the trouble. As the prognosis is favourable, the patient should not be sent to an asylum if she can be guarded at home.

Paralysis.—Various pareses and paralyses have no effect

on pregnancy or labour. Even in paralysis of the abdominal muscles labour may be slowly performed by the unaided uterus. Paralyses appearing during pregnancy may have their cause in the central nervous system, and may be permanent; others may pass away after labour. Pareses of the lower limbs, due to pressure, are of small importance, and recover when the pressure is removed.

Epilepsy.—Many women of epileptic tendency have their first well-marked fits during pregnancy, due, doubtless, to the presence of a local irritant in the uterus, and heightened nervous sensibility. The fits are distinguished from eclamptic seizures by the presence of an ora, and by the characteristic cry of epilepsy. Tetanus is rare in pregnancy, but must be excluded in diagnosis. Hysterical convulsions are much commoner, and must be carefully distinguished from more genuine disease. After labour, the epileptic fits often cease, but they may continue, so prognosis should be guarded. The treatment is as usual, bromides being of great service.

Chorea.—After childhood, chorea is seldom seen apart from pregnancy. It appears in young primiparae who may have had it in childhood, or may only have a neurotic family history. The rheumatic diathesis is an important factor, and on investigation it will be found that most of the subjects have had rheumatism, endocarditis, rheumatic tonsilitis, or other rheumatic symptoms. The heightened nervous sensibility of pregnancy predisposes to the attack, which is often initiated by some emotional crisis. Unilateral movements may first appear, but in bad cases they are bilateral, and interfere with sleep by their violence. Wasting and pareses follow, and mental disturbance may appear. The prognosis is very grave, as the mortality of 5.7 per cent. in childhood rises to 27.3 per cent. in pregnancy. Abortion, followed by recovery, occurs in about 50 per cent. Recovery before labour is rare; after labour it is usual. The treatment, beyond what is usual in chorea, consists in the induction of abortion or premature labour. This should

be done if death from exhaustion is threatened, or, indeed, if sleep is prevented.

Sleeplessness.—This is itself a serious condition, and may be the cause of mental trouble. It should be treated by fresh air, exercise and food at bedtime, avoiding, if possible, opiates, alcohol, and other soporifics, though it may be necessary to employ them ultimately.

Neuralgia.—The hyper-æsthetic nervous system suffers from varied neuralgic pains. If any teeth are decayed they will ache. Headache is common. Sight and hearing may be painfully exalted or depressed. Pain in the breasts and inframammary regions is common. These manifestations must be relieved by aperients and carminatives. Iron, quinine, arsenic, and strychnine will be useful, as the hyper-aesthesia is partly the irritability of weakness. Sedatives, such as belladonna and the bromides, heterodox as it may appear, may well be combined with nerve tonics.

Shock.—The result of shock from traumatism or surgical operations upon pregnancy varies very widely. In many cases abortion or premature labour is caused, so operations should be postponed till after pregnancy if possible. Removal of tumours by abdominal section is, however, frequently performed without interrupting gestation; so if there is probability that any new growth will interfere with labour, it should be removed early in pregnancy.

Haemopoietic System.

Spleen.—This organ is often enlarged during pregnancy, a sort of leucocytosis being characteristic of the state. Rupture of the softened organ has occurred at labour.

Thyroid. — Enlargement of the thyroid is a classical symptom of pregnancy, the thick neck of the pregnant woman being referred to by Catullus. Goitre or bronchocele beginning during pregnancy may pass away after it, or may remain permanent, and may become exaggerated during future pregnancies.

Blood.—It must be remembered that in pregnancy there are normal changes in the blood. Its red corpuscles and its albumen are reduced, the white corpuscles and the fibrin being increased. The water is increased from 719 to 817 in 1000 parts. The total quantity of blood is increased and the arterial pressure is raised. Exaggerations of these normal variations cause morbid conditions.

Anaemia.—Thus a degree of chlorosis is usually present. A vascular bruit may be heard in the neck. If blood be drawn and allowed to stand the red corpuscles sink quickly and a "buffy" coat forms as in the blood of horses or rheumatic patients. If pallor, headache, palpitation, shortness of breath follow, the condition calls for careful attention. But if the symptoms of pernicious anaemia appear, the prognosis becomes very grave. This mostly occurs in multiparae between the ages of twenty-four and thirty-six, or after a series of pregnancies in rapid succession. The treatment is, as usual, by iron supported by arsenic, phosphorus, and quinine, dyspeptic symptoms having been removed by a little rhubarb, soda and bismuth, or by mineral acids and bitters. If the anaemia is extreme, gestation may be interrupted artificially, and if symptoms of pernicious anaemia appear, this must be done without delay, and without waiting to try the effect of arsenic or the antiseptic treatment by β naphthol.

Haemorrhages.—The changes in the blood make the pregnant woman more than usually liable to haemoptysis, haematemesis, epistaxis, haematoma, haematocele, and other blood losses.

Haemophilia.—In the inherited, congenital, and constitutional condition known as haemophilia, there is extreme danger in pregnancy and labour. If a woman be known to be a "*bleeder*" it is doubtful if she should be allowed to marry. In families of bleeders, however, the females usually merely transmit the tendency, while the males exhibit the symptoms.

Circulatory System.

Chronic Heart Disease.—It must be remembered that more or less hypertrophy of the left ventricle is normal in pregnancy. Any form of heart disease may cause premature expulsion of the ovum. All forms of heart disease are aggravated by pregnancy and labour, though in many slight cases a woman may bear children without her heart condition becoming perceptibly worse. Mitral lesions are those most frequently met with, and of these, mitral stenosis is more serious than mitral incompetence. Compensation is upset near mid-term, and distress begins, with the usual train of symptoms of backward pressure. Distress will begin earlier if the lesion is of recent origin. Dyspnoea, passive venous congestion of the lungs, and oedema of the limbs appear, and there may be fresh endocarditis. The left auricle dilates, then dilatation of the right side of the heart follows. The importance of these conditions is paramount in labour, especially in the third stage. (See Complications of Labour.)

Mitral regurgitation is of less importance, because, as the blood can escape in front, there is less backward pressure. Aortic stenosis is a rarer condition, but has the same results as mitral stenosis. Aortic regurgitation is still rarer perhaps; it is said frequently to cause abortion.

The dangers of heart lesions in pregnancy are doubtless much exaggerated, but the risk of labour in cases of mitral stenosis is very real. Marriage in cases of marked mitral stenosis should therefore be prevented if possible, and in bad aortic stenosis the same holds true. Women with aortic regurgitation are unfit subjects for matrimony, apart from the risks of labour.

In the case of a pregnant woman with heart disease, the prognosis depends upon the lesion, as above indicated, and upon progressive changes in it. With dyspnoea, palpitation and some oedema, pregnancy may terminate favourably, but

with pulmonary congestion and dilatation of the right side of the heart the prognosis becomes very grave. Ascites, albuminuria, and haemorrhages make it still worse.

The pregnant woman with a cardiac lesion must be seen frequently, rest must be enjoined, and iron, arsenic and strychnine may be regularly administered. Symptoms of distress call for the use of strophanthus and digitalis. Besides strengthening the action of the heart, digitalis contracts the arterioles, and so increases the resistance the heart has to overcome. By giving a nitrite along with digitalis the contraction of the arterioles is prevented, and the heart is not called upon to overcome a raised arterial resistance. Gestation may end prematurely, and hot douches may be given to favour this termination. It may be necessary at any stage to empty the uterus by active interference, but this should be a last resource, as the result is often unfavourable.

Acute Endocarditis.—Fresh ulceration often occurs in old heart disease during pregnancy. Embolism may follow in the head or lung. A primary attack of endocarditis during pregnancy is of rare occurrence.

Varicosity and Haemorrhoids.—The general venous engorgement of the lower parts of the body during pregnancy tends to cause varicosity of the limbs, pudenda and rectum, and aggravates these conditions when pre-existent. Piles become inflamed, internal ones bleed and may cause serious loss of blood. The limbs may be bandaged and should be raised when possible. It may be necessary to confine the patient to the recumbent posture and to apply elastic pressure to the vulva with a pad of wool. The usual haemostatics and astringents must be used for piles.

Respiratory System.

Dyspnoea.—Early in pregnancy a sort of asthmatic condition is sometimes troublesome, which is probably of reflex nervous origin. Later the growing uterine tumour interferes with the movements of the diaphragm and causes

difficulty of breathing, which is somewhat relieved during the last two or three weeks of pregnancy. There is often a nervous cough without any expectoration. The excretion of CO_2 is increased during pregnancy, and the mere increase of the respiratory function may cause some dyspnoea.

Phthisis.—It is said that 11 per cent. of women dying of phthisis first showed it during pregnancy, and 13 per cent. after labour. As in tubercular processes generally, the disease makes rapid strides during the puerperium and lactation, though it may have been apparently retarded during pregnancy. (See Tuberculosis.)

Pneumonia. — Lobular pneumonia and broncho-pneumonia have no definite relation to pregnancy, nor has bronchitis. The dyspnoea of the state adds to the discomfort of all respiratory disorders. Lobar pneumonia has been considered as an infective fever.

Alimentary System.

Morbid cravings and irregularity of appetite are common in pregnancy, and are of nervous origin. So also is the profuse **salivation**, which often begins early and continues throughout gestation. The mucosa of the mouth may swell, the gums remaining healthy. This condition often disappears as the uterus becomes an abdominal organ. It may demand treatment by sucking ice, and by bitters and carminatives. Belladonna or iodides may be useful.

Nausea and Vomiting.—The slight morning sickness which is so common as to be a symptom of pregnancy is hardly pathological. But it may continue after the fourth month, and may cause rejection of part of every meal. Nausea may be felt between meals, and, at last, no food may be retained. This is a serious condition and has frequently ended fatally. In some cases the condition begins after the sixth month in association with kidney trouble and albuminuria. In others it is associated with morbid conditions of the uterus or with particular neurites. Weak-

ness and anaemia follow the malnutrition caused. The temperature may rise first in the evening and then permanently. The vomiting and fever may then be replaced by syncopal attacks and delirium, leading on to coma and ending in death. The possibility of organic disease of the stomach must be borne in mind.

The bowels must be regulated. Bismuth, in 10 to 30-grain doses, or Oxalate of Cerium in 5 to 10-grain doses may be useful. Hydrocyanic acid, nitrate of silver, nitric acid, phosphoric acid, salicin, naphthol, creosote, iodine and other drugs have been used. Cocaine in $\frac{1}{8}$ to $\frac{1}{3}$-grain doses is useful, as is morphia in various forms. Sinapisms applied to the epigastrium often give relief. Uterine displacements should be rectified. Cervical catarrh or erosions are often successfully treated by applying nitrate of silver locally. Separation of the membranes round the cervix is said to have given relief. Ice, aerated waters, and pre-digested food are useful in the nutrition of the patient, and it may be necessary to use nutrient enemata and inunction of oil. Gestation must be interrupted at any stage when needful, delaying the measure, if possible, till a viable child can be delivered.

Heartburn.—Heartburn and water-brash usually occur late in pregnancy, and are treated, as usual, by alkalies, carminatives and attention to diet, reduction of the size of the meals often being necessary.

Constipation.—Early in pregnancy the pressure of the uterus may cause constipation. Later, the abdominal tumour interferes with the peristaltic movement of the intestines. Alternately, diarrhoea and constipation often attend the morbid cravings of pregnancy. Diarrhoea of irritative origin may follow constipation. The treatment should not be by cathartics. A little cascara may be given every night. Nux vomica or strychnine may be given continuously in small doses. Diet should be regulated, and exercise enjoined.

Jaundice.—Late in pregnancy obstructive jaundice may be caused by pressure; catarrhal jaundice may occur at any stage. These conditions must be treated as usual. Their importance in pregnancy is due to the possibility that they may be precursors of acute yellow atrophy of the liver.

Yellow Atrophy.—This disease is curiously connected with pregnancy, as many as twenty-nine out of sixty-nine cases having occurred in pregnant women. It begins, usually early in pregnancy, with malaise, constipation and discolouration of the skin, but this symptom may be the first to appear. Vomiting of mucus, bile and blood may follow, then coma and convulsions. The bowels may become open, and stools containing bile and blood may be passed. The urine is scanty and high coloured, leucin and tyrosin being present. The temperature may be high; but the pulse is slowed by the presence of biliary matter in the blood. Atrophy of the liver is evident on percussion. Abortion may occur, in which case recovery is possible. The extreme condition of the patient usually negatives any attempt to empty the uterus. Death may occur in from twelve hours to six days. Post mortem, heart and renal disease are often found in addition to the morbid condition of the liver.

Urinary System.

Incontinence.—During the early months the pressure of the uterus on the bladder may cause frequency of micturition and even incontinence of urine. The use of a suitable pessary may relieve this, and the trouble will pass as the uterus becomes abdominal. Later in pregnancy the uterus again presses more upon the bladder than at mid-term. The parts are now all softened and relaxed, and the retentive power of the bladder is thus impaired.

Retention.—The pressure of the growing uterus may also

cause retention of urine, especially if the organ is displaced. The bladder, as it becomes distended, may drag up the uterus, so allowing urine to flow after a period of retention. Posturing may relieve the condition, and a patient can often empty the bladder while lying on the back. The use of the catheter may be necessary.

Albuminuria.—The urine of from 3 to 5 per cent. of all pregnant women is said to contain albumen, the condition being commoner in young women, and especially in primiparae. As vaginal discharge is frequently mixed with the urine, it cannot be stated that albuminuria is present till a catheter-drawn specimen has been examined.

1. The presence of the albumen may be due to a catarrhal condition of the bladder, or to a transitory and functional disturbance, such as is often seen in healthy subjects.

2. Again, it may have existed before pregnancy began, being due to kidney disease of old standing; or it may arise during, but not on account of, pregnancy, having an independent cause such as cold, scarlatina, or heart disease.

3. Lastly, in some subjects, and under some circumstances, pregnancy seems to cause a disease one manifestation of which is acute renal inflammation with albuminuria, another being the convulsive seizures known as *eclampsia*. This may come on during pregnancy, at labour or during the puerperium.

The main interest of albuminuria in pregnancy is due to its connection with eclamptic seizures. Ignoring the idea that the convulsions cause albuminuria, it remains to be proved that the kidney condition causes the convulsions. It is, indeed, more probable that the nephritis and the convulsions have their common cause in some deeper change depending upon the pregnant state. Some error in metabolism is most likely the cause of the clinical entity known as eclampsia, and, in the present phase of medical science, it is not remarkable that a microbe has been suggested as

the *fons et origo* of the trouble. As eclampsia must be discussed in its relation to labour, we defer its consideration (see Complications of Labour) and confine our attention to albuminuria apart from convulsions.

Various reasons have been given why albumen should appear in the urine during pregnancy, and why pre-existing albuminuria should be aggravated by that state.

1. Pressure on the renal veins, causing passive venous congestion of the kidneys. This would not cause acute nephritis.

2. Pressure on the ureters, causing dilatation of ureters and kidneys, which is said to be found in 25 per cent. of eclamptic cases P.M.

3. Increased work thrown on the kidneys by the excretion of additional urea from the foetus.

4. Increased arterial pressure of pregnancy.

5. Reflex nervous irritation of the kidneys.

The various diseases causing albuminuria follow, during pregnancy, their usual courses. They produce, as usual, oedema, uraemic coma and convulsions, paraplegia, hemiplegia, facial paralysis, impairment of sight (albuminuric retinitis) and of other special senses. They are aggravated by pregnancy, and they often cause the death of the foetus and its premature expulsion.

When this symptom is present, prognosis will be dominated by the fear of eclampsia. In chronic kidney disease, and when much oedema is present, this is not very likely to follow. The patient must be watched and the urine frequently tested, small amounts of albumen being disregarded. If other symptoms appear, milk diet, warmth, warm baths and warm clothing must be enjoined. Iron, diuretics and aperients will be administered if necessary. If chronic kidney disease is present no attempt need be made to keep the patient on a rigid milk diet. Pregnancy must be ended artificially at any stage if the symptoms demand it.

Glycosuria.—The presence of sugar in the urine is an alarming symptom, as diabetes is aggravated by pregnancy. The mother often dies during the puerperium. The foetus is often expelled prematurely, and frequently dies in utero or soon after birth. Matthews Duncan mentions the occurrence of diabetes during 22 pregnancies in 15 women, 4 of whom died during the puerperium. Out of 19 children 7 died during pregnancy and 2 soon after birth. Hydramnios is frequent, and sugar has been found in the liquor amnii. The treatment is as usual.

Skin.

Pruritus, generally spreading from the vulva, may attack the whole skin. This is commonest in the second and third months, and often passes away as pregnancy advances. The urine should be tested for sugar, as the itching may be a symptom of diabetes. Otherwise it must be considered to be a neurosis, and treated as such, say with nux vomica or valerianates. Lotions containing hydrocyanic acid, borax or phenol may be useful.

Acne, eczema and urticaria are not uncommon, and herpes is frequent, especially on the buttocks. It has been called during pregnancy **herpes gestionalis**. The nervous origin of this and other skin conditions must be remembered. The treatment is as usual.

Reproductive System.

Pruritus Vulvae.—Itching of the private parts often originates in a leucorrhoeal discharge. It may spread over the inner sides of the thighs and on to the buttocks. Like general pruritus, it is commonest in the second and third months. There may be ascarides in the rectum, in which case the treatment consists of enemata containing common salt. Vaginitis and vulvitis must be relieved by mild anti-

septic and astringent douches. The subacetate of lead may be useful. After bathing, ointments containing bismuth, zinc, cocaine or carbolic acid in vaseline and lanoline will be useful. The urine should be examined for sugar.

Oedema.—This condition may affect the vulva in common with other parts in kidney and heart disease, or it may be local and caused by pressure of the uterus. The recumbent posture may be enjoined, and the urine and heart should be examined.

Leucorrhoea.—The normal increase of the vaginal secretion during pregnancy may be exaggerated so as to cause inconvenience. The vagina and cervix should be examined, as endocervicitis is often found to be the cause of the discharge, and may demand treatment by applications of iodine, phenol, or nitrate of silver. Excessive discharge must be relieved by astringent douches, which must not be too warm. Boracic acid or alum, ℥i to a quart of water, will serve in simple conditions. If gonorrhoea is the cause, sulphate of copper, ʒi to a quart, or sulphate of zinc, ʒii to a quart, should be used. If syphilis be suspected, corrosive sublimate, 1 part to 4000, is indicated, and there is no better astringent and antiseptic lotion than this, whether the condition be simple or infective. The biniodide of mercury may also be used.

Hydrorrhoea.—A continuous or intermittent free watery flow from the vagina is known as hydrorrhoea or metrorrhoea gravidarum. Its source has been explained as possibly due to the escape of liquor amnii through a valvular aperture in the membranes, or to cervical catarrh, a more feasible but inadequate explanation. Cancer of the cervix and sarcomatous disease may cause a free watery flow during pregnancy as at other times. A similar discharge is common in herpigenous degeneration of the ovum (hydatid mole), and in a form of endometritis where the vera and reflexa remain vascular, and continue to grow instead of becoming thin and non-vascular after their

union. Blood serum sometimes exudes, when it may coagulate or may escape as a watery discharge. This condition often causes abortion. The appearance of hydrorrhoea therefore demands a careful physical examination, and treatment according to the diagnosis arrived at.

Bleeding.—During pregnancy menstruation may occur once or twice before the union of the vera with the reflexa. Bleeding may occur in various morbid conditions of the cervix, including simple inflammatory conditions, polypus and malignant disease. Other bleedings in the early months must be considered as symptomatic of threatened abortion. In the later months bleedings occur in connection with "placenta praevia" and "accidental haemorrhage," and will be discussed as complications of labour.

Endometritis.—Acute endometritis occurs in febrile conditions of the mother, and in connection with degenerations of the ovum. Maternal backward pressure may cause congestion followed by inflammation, with cloudy swelling and fatty degeneration of the decidua and its cells. Chronic endometritis causes overgrowth and thickening of the deciduae with slight haemorrhages and thromboses. These may cause abortion at any stage, or may produce a thick fibrous spongy layer which will not tear through, so causing adherent placenta. Polypoidal excrescences of the endometrium may be found without glands, but otherwise resembling the structure of the mucosa. Cysts occur, due to obliteration of the necks of follicles. These conditions usually cause haemorrhage and early abortion. Atrophic and degenerative conditions of the decidua are also described.

Mesometritis. — Disease of the muscular wall of the uterus is usual in acute febrile and other conditions. It also occurs in displaced uteri. There may be softening and fatty degeneration of the muscle fibres so extensive as to end in rupture of the uterus during labour.

Perimetritis. — During pregnancy old peritonitic ad-

hesions between the uterus and other viscera usually become relaxed. They may, however, cause abortion, and sometimes they cause difficulty at labour.

Fibroids. — Submucous fibromyomata usually prevent conception or cause early abortion. Interstitial fibroids have to a certain extent the same effects. They also cause softening and enlargement of the muscle, and so interfere with the contractions of the uterus. They also cause haemorrhage and may obstruct the parturient passages. Subperitoneal fibroids may produce no symptoms till labour. They may cause difficulty in diagnosis, as they may be mistaken for the pregnant uterus, for part of the foetus, or for a second foetus. They produce bad presentations and interfere with uterine action, and may obstruct the passages. Necessity for treatment usually arises only during labour.

Carcinoma.—Cancer of the body of the uterus prevents conception. Cancer of the cervix is often found during pregnancy, so that it must have allowed of conception or have begun after it. Bleeding and hydrorrhoea may occur, gestation continuing. If the uterus can be removed by hysterectomy this should be done. If the growth is too far advanced to admit of complete removal, it is advisable to end the pregnancy artificially, in order that the progress of the disease may not be rendered more rapid by the vascularity of the parts. If pregnancy is far advanced, abdominal section may be necessary.

Displacements of Uterus.—These may arise early in pregnancy, or may have existed before conception.

Downward displacement.—The uterus normally sinks at the beginning of pregnancy, but it may continue to descend, following the usual mechanism of prolapse. The anterior vaginal wall first protrudes at the vaginal orifice, followed by the cervix and the posterior vaginal wall, till the prolapse is complete. It may occur suddenly, and is usually seen in women who have previously suffered from the condition. Abortion is very likely to be the result. Urinary trouble

is usual. The condition must be distinguished from hypertrophy of the cervix. It may be sufficient to support the uterus with a pessary, to which may be added a pad and

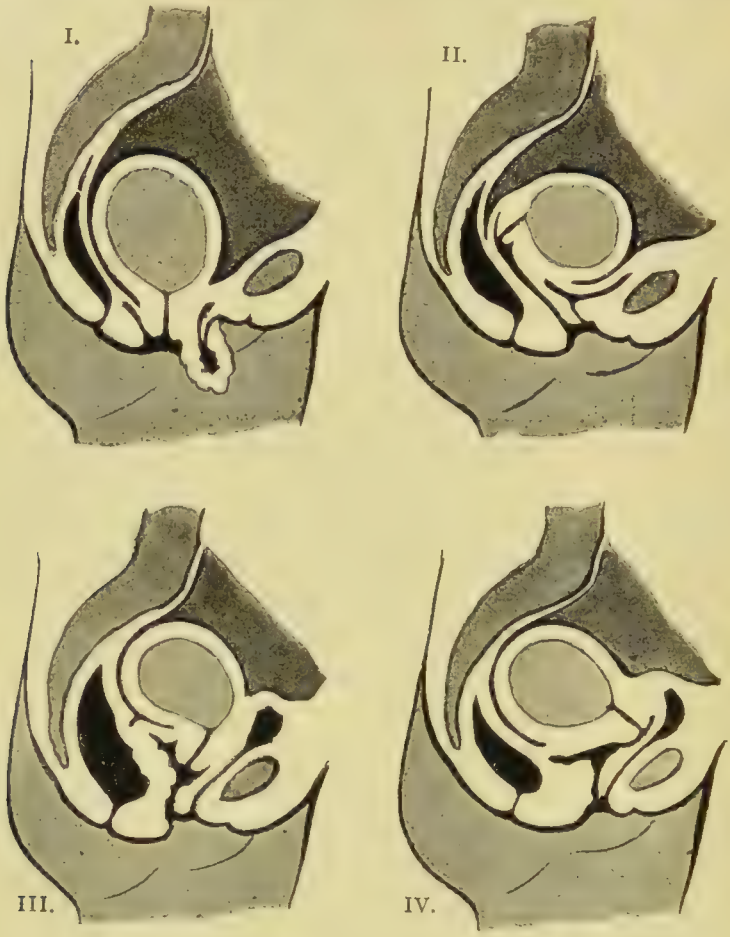


FIG. 12.—Diagrams to give an idea of the position of parts in displacements of the gravid uterus.

I. Downward—showing how the uterus is retroverted, the anterior vaginal wall descending in partial prolapse.
II. Forward—Anteflexion.
III. Backward—Retroflexion.
IV. Backward—Retroversion.

a T bandage, but the patient must generally be kept at rest in the recumbent posture. The size of the uterus will then

as a rule cure the condition from the fourth month until the end of pregnancy. Prolonged rest during the puerperium may prevent recurrence.

Forward displacement.—Anteversion to a slight degree is normal at the beginning of pregnancy, but it may be excessive and combined with pathological anteflexion. Pressure on the bladder causes early symptoms, while later in pregnancy the fundus may protrude between the separated recti. This only occurs where there is weakness of the abdominal wall, or contracted pelvis, and it must be met by providing a suitable bandage, binder or abdominal belt.

Backward displacement.—**Retroversion** of the gravid uterus may occur alone or with retroflexion superadded. It is most frequently seen in women whose uterus was retroverted or retroflexed before pregnancy; but it also occurs in those whose uterus is usually mobile. It is mostly in multiparae that the condition is due to excessive mobility of the uterus. In primiparae it is usually caused by contraction of the pelvis—the promontory of the sacrum impeding the upward growth of the uterus. The displacement is said to be sometimes caused by a fall or other accident, and it has been suggested that the uterus may be pushed backwards by a distended bladder. At first there are no symptoms, but as the uterus grows it causes trouble by pressing on the bladder and rectum, bearing-down pains may be experienced, and vomiting is often severe. If the condition persists after the fourth month, the fundus lies in the hollow of the sacrum, and presses on the rectum, causing increased difficulty in defaecation. The cervix is high up and to the front, and causes retention of urine by pressing on the urethra. The distended bladder forms an abdominal tumour, and as it rises it lifts the uterus by pulling on the utero-vesical ligaments, so relieving the pressure on the urethra, and allowing the urine to dribble away.

The result may be as follows :—

1. Most frequently the condition rights itself as the grow-

ing uterus escapes gradually or suddenly from the pelvis at the fourth month to become an abdominal organ.

2. The greater part of the uterus may grow up into the abdomen, leaving a small part in the pelvis arrested by the promontory of the sacrum, so that at labour a saccule is found at the lower and posterior part of the uterus.

3. The uterus may be completely incarcerated in the pelvis. In this case the prognosis is grave, as decomposition may occur in the retained urine, with sloughing of the mucosa of the bladder, and even of its muscular wall, and of other pelvic organs. Abortion frequently occurs, and may be followed by inflammatory changes, resulting in septic pelvic abscess. Backward pressure from the bladder may cause kidney trouble and uraemia.

Given that pregnancy is present, the diagnosis should not be difficult. The abdominal tumour caused by distension of the bladder is easily recognised, and disappears on catheterisation, unless, indeed, the separated vesical mucosa cling round the end of the catheter, and prevent the urine from entering it. It may suggest hydramnios. The posterior wall of the uterus and the fundus are felt from the vagina and rectum. The cervix may be so high as to lie behind the pubic symphysis out of reach. Bimanual examination, after the bladder and rectum have been emptied, will make clear the condition, which, however, has been mistaken for ectopic gestation.

When the case is seen before the uterus has become incarcerated, the uterus must be supported by a pessary or vaginal plug, and the patient must be kept at rest till the uterus has grown so large that it cannot again drop into the pelvis. When incarceration has occurred, the bladder must be emptied. If exfoliation of the vesical mucosa renders this impossible by a catheter, suprapubic aspiration of the bladder must be done. The rectum and lower intestine must then be emptied. If an ordinary enema will not effect this, an india-rubber tube, attached to a funnel, may be

passed into the rectum. Then, by pouring warm water into the funnel, and then lowering and inverting it, and repeating this process frequently, the organ can be thoroughly washed out. The patient must next be placed in the genu-pectoral posture, kneeling with the head and chest as low as possible. Gentle manipulation will now often suffice to move the fundus forward and upward into the abdomen. Pressure should be directed so as to move the uterus to one side or the other of the promontory. If difficulty is met with, an anaesthetic should be given, and further manipulation made in the lateral posture. If this fails, the patient may be put at rest for a day, an opiate being given, and hot douches being used at suitable intervals. The attempt to raise the uterus may then be repeated. It may be useful to draw the cervix downward with a volsella while pushing the fundus upward. If this succeed, the patient must be kept in bed till the uterus has grown considerably, and there is no possibility of its falling again into the pelvis. Plugging of the vagina may be necessary to support the uterus during the first few days. If it is impossible to replace the uterus, abortion must be procured. This will be done through the cervix, if it is accessible, otherwise an aspirator must be passed through the posterior wall of the uterus, and the liquor amnii drawn off. A few hours later it may be possible to replace the uterus, after which the treatment of the resulting abortion will be easy.

Hernia.—The uterus occasionally lies in a hernial sac, inguinal, femoral, or umbilical. It may become pregnant, when abortion will usually occur naturally, or may be induced, after which the hernia may be reducible. If not, the operation for its relief should usually begin with abdominal section, and may end in hysterectomy.

CHAPTER VIII.

PATHOLOGY OF PREGNANCY—*Continued.*

MALFORMATIONS OF THE UTERUS.

Development.—Early in development the female reproductive canal consists of a pair of separate oviducts, the Müllerian ducts. After the eighth week the lower portions of these tubes unite to form a single tube in the middle line. The lower thirds of the two Müllerian ducts unite to form the vagina; the middle thirds unite to form the uterus; while the upper thirds remain distinct and form the two Fallopian tubes.

Comparative.—The stages in the development of the human subject correspond to the varying stages which development has reached in the lower mammals. For in Marsupials the typical condition is to have the two Müllerian tubes separate throughout, *i.e.*, paired vaginae, uteri and oviducts.

In the rabbit the lower portions of the tubes are fused into a single vagina, whose double origin is shown by a trace of a septum at its upper end; while the uterine portions remain quite distinct, and open by separate ossa into the vagina.

In most Rodents and Cheiroptera the two uteri are fused below and have a single aperture into the vagina. A septum partially divides the fused portion, and the upper portions are quite separate.

Commonest is the bicornuous uterus of the Ungulata and Carnivora, in which the uterine portions of the two tubes are

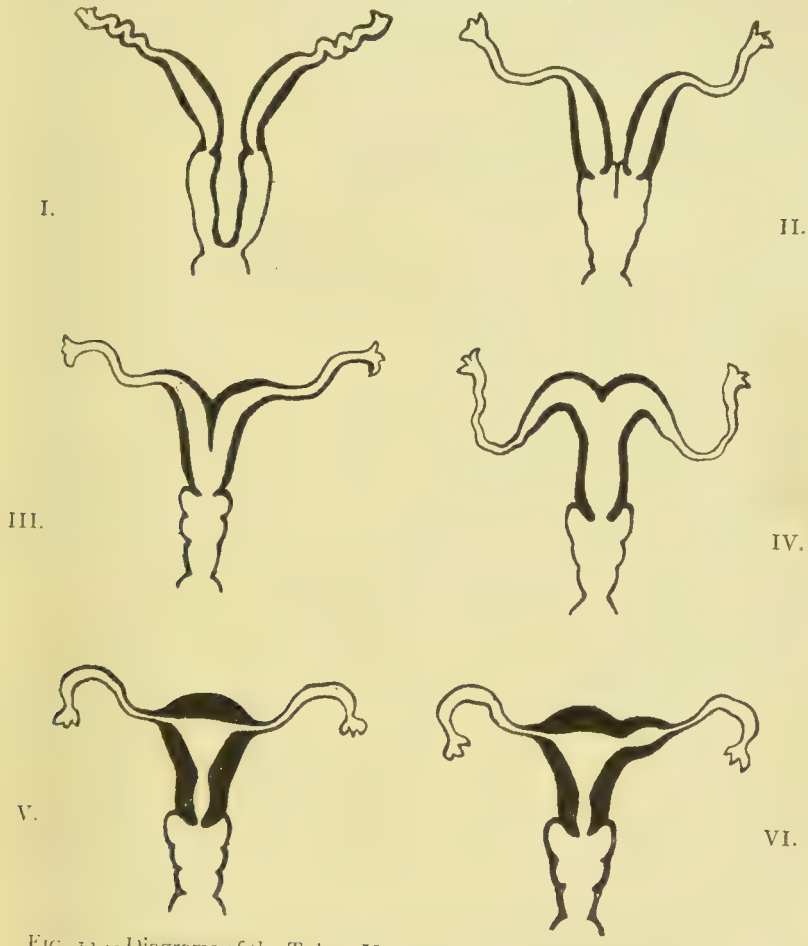


FIG. 13.—Diagrams of the Tubes, Uterus and Vagina in different Mammals, representing also the malformations which occur in man.

I. Double uterus and vagina (some Marsupials).
II. Double uterus, vagina partly divided by septum (rabbit).
III. Uterus single below but double above (most Rodents and Cheiroptera).
IV. Uterus single but with two horns (Uterus bicornis of Ungulata and Carnivora).
V. Single uterus (man and apes).
VI Uterus with rudimentary cornu (Uterus unicornis cum cornu rudimentario of man). The Uterus unicornis of man is not figured.

fused throughout most of their extent, a separate upper portion leading to each oviduct. The main uterus is thus single but its cavity is forked at the top.

In man and the apes the uterine portions are fused into a single mesial uterus, the oviducts only being separate.

Malformations in Homo.—Development may be permanently arrested at any stage, causing congenital malformations of the reproductive system in woman. Thus we may have a double vagina, or one divided by a septum in its upper portion, but single below. The uterus may be double, opening into the vagina by separate ossa. Again, the uterus may have a single cavity opening by a single os, but divided by a septum above, or forking into two cornua, each leading into a Fallopian tube (Uterus bicornis).

But, in addition to these symmetrical arrests of development, we have certain malformations due to the unequal growth of the two Müllerian ducts. Thus arise the single uterus with a rudimentary horn (Uterus bicornis cum cornu rudimentario) and the uterus from which one Fallopian tube is entirely absent (Uterus unicornis).

Pregnancy in malformed uteri.—Pregnancy may occur in uteri malformed in any of these ways. In the uterus unicornis there is nothing to interfere with the normal course of events, and the absence of a Fallopian tube need never be discovered. In the uterus bicornis, provided that the horns are well developed and muscular, pregnancy ended by normal labour may occur in either or both. Uteri of this form afford the best opportunity for the occurrence of superfoetation. The deformity may be discovered at labour or may escape observation.

The occurrence of pregnancy in the rudimentary horn of a bicornuous uterus is very rare. Many of these horns are connected with the uterus by a solid mass of tissue, the cavity of the horn not communicating with that of the uterus. Ova developing in such cavities can only be fertilised in two ways. Either there must be, before pregnancy, a communication between horn and uterus sufficient to allow of the passage of spermatozoa, or the ovum must be impregnated

by a spermatozoon which travels up the Fallopian tube of the opposite side. Cases are recorded in which no communication whatever could be traced between the cavities of the horn and the uterus, the corpus luteum corresponding to the fertilised ovum being sometimes on the same side as the horn, sometimes on the other side. These cases seem to show that the ovum can wander across the peritoneal cavity and travel down the tube of the opposite side to that on which it was shed from the ovary.

The result of pregnancy in a rudimentary horn varies with the size and strength of the horn. A small cornu with walls containing little muscle cannot grow fast enough to contain the growing ovum, and will burst, usually causing the death of the mother by shock and haemorrhage. Rupture occurs after the third month, in general somewhat later than in tubal pregnancy. The rupture may be into the broad ligament, or into the peritoneal cavity, or both.

In a strong and muscular horn, gestation may continue till full time. The foetus may die during pregnancy or at term, and may be retained in the gestation sac in a shrunken or calcified condition. A sort of spurious labour may occur at term, when, the foetus being retained, the case may be regarded as one of missed labour.

During life it is practically impossible to distinguish this condition from tubal pregnancy. On examination of specimens, gestation sacs *external* to the insertion of the round ligament may be considered as tubal, those *internal* to the point of insertion as cornual. A gestation sac developed in the interstitial part of a tube may have the round ligament inserted neither external nor internal to it but into its surface, and other features of its structure must be considered in forming a conclusion. Prognosis and treatment are as in tubal pregnancy.

ECTOPIC GESTATION.

Syn.—EXTRA-UTERINE PREGNANCY.

Development and Course.

We now pass to the consideration of gestation altogether outside the uterus, that is to say, in the Fallopian tube. It is stated that an ovum can develope in ovarian tissue and also on the peritoneum; but these hypothetical forms of gestation are every day becoming more purely historic in their interest. They probably do not occur.

Tubal pregnancy is not confined to any special portion of reproductive life. It is, however, much less common in primiparae than in multiparae, in whom it frequently follows a period of sterility. In by far the greatest number of cases gestation begins in the ampullary part of the tube. A woman may become pregnant in both tubes at the same time or at different times. Tubal gestation has also gone on together with uterine pregnancy, which may also proceed undisturbed by the presence of the remains of a tubal pregnancy which has for years been incarcerated in the mother.

The foetus, if it survive to full time, and happen to be removed alive from the mother, may be well formed and healthy, but the majority of such children are feeble and ill-developed, and die soon after birth.

When a fertilised ovum grafts itself in the lumen of a tube, the mucosa of the tube undergoes changes quite similar to those which occur in the uterine mucosa, while the ovum behaves exactly as if it were in the cavity of the uterus. It attaches itself first by a trophoblastic layer of epiblast cells, next by villi springing from the whole chorion, and permanently by the developed villi of a true placenta. In the tubal mucosa decidual cells are formed, the epithelium degenerates and is partly lost, and the vascular arrangements are altered to form a nidus for the ovum. A

superficial compact layer and a deeper spongy layer of decidua are formed. The serotina is larger in proportion

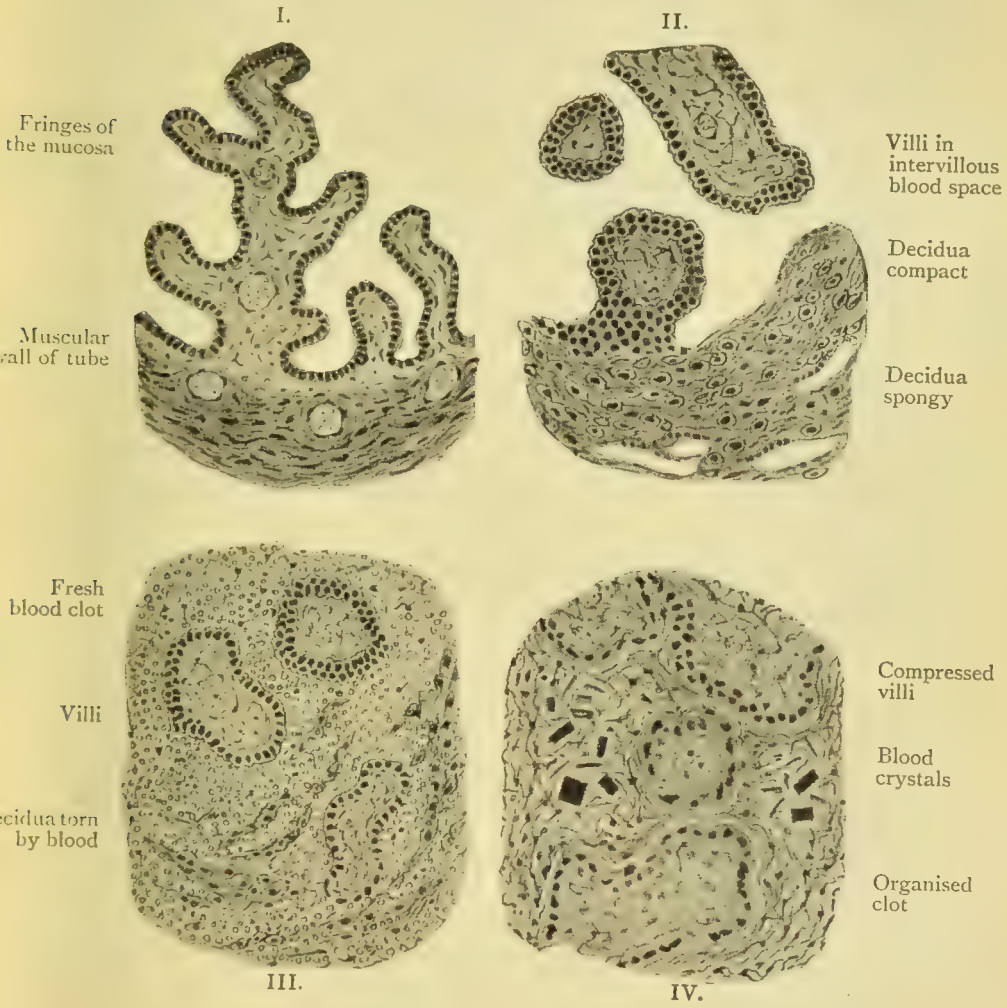


FIG. 14.—Ampullary Gestation; micro-sections from nature.

I. Normal mucosa of tube.

II. Mucosa of tube showing decidual changes. Epithelium lost; large decidual cells formed; Villi, one of which is attached to decidua.

III. Blood extravasation has recently torn up the decidua; organisation of the clot commencing.

IV. The clot organised, destroying the villi; blood crystals have formed in the clot.

to the vera than in uterine gestation. There is not much space in the lumen of a tube for the formation of a reflexa,

but the development of one is at least attempted. In the wall of the tube there is at first hypertrophy of the muscular elements; but after the first three months the wall of the sac consists mainly of connective tissue, the muscle fibres being stretched, thinned and scattered. The wall varies in thickness from $\frac{1}{32}$ to $\frac{3}{16}$ in. (Webster). The peritoneum covering the tube grows to some extent; but as the tube enlarges it separates the layers of the broad ligament, and thus derives a peritoneal covering, absent only along its lower side. The peritoneum over the sac often becomes inflamed, and forms adhesions with neighbouring viscera.

Thus the ovum developes in a sac which is lined by membranes and placenta; it is formed by the wall of the tube, and is covered by peritoneum derived from the broad ligament, except along its lower surface, where it is in contact with the connective tissue between the layers of the broad ligament.

The walls of the sac may grow fast enough, and remain strong enough to retain the ovum even till full time. But usually the wall of the tube gives way, allowing the escape of part of its contents, and then one of two things must happen, according to the position of the tear. For the rupture must occur either **through the peritoneum**, or else at the lower part of the sac, **between the layers of the broad ligament**, so escaping the peritoneum. Part of the ovum will pass out of the primary sac of tube wall, either through the peritoneum into the peritoneal cavity, or between the layers of the broad ligament into the pelvic connective tissue.

The tearing of the vessels in the sac wall allows of haemorrhage, and the blood escaping passes either into the peritoneal cavity or into the pelvic connective tissue, according as the peritoneum is torn or not.

The patient may die from shock and haemorrhage at the time of rupture or soon after. On the other hand, she may recover, and the gestation may continue in its secondary

position, a secondary gestation sac being formed to contain that part of the ovum which escaped at rupture from the primary sac. The gestation is now called **tubo-peritoneal**, or secondary abdominal if the peritoneum was torn; but if the gestation is still completely beneath the intact peritoneum it is called secondary extra-peritoneal, intra-ligamentous, or **sub-peritoneo-pelvic.**

Gestation continuing in the tubo-peritoneal form, the sac grows up from the pelvis into the abdomen uncovered by peritoneum. Gestation continuing in the extra or sub-peritoneal form, the sac grows up into the abdomen, lifting the peritoneum above it, so later gets the name **sub-peritoneo-abdominal.** A rupture of a sub-peritoneal sac through the peritoneum, part of the contents escaping into the peritoneal cavity, will produce indirectly the same result as a primary rupture of the peritoneum—*i.e.*, a tubo-peritoneal gestation. If this is called abdominal, it must be tertiary abdominal, as it becomes abdominal in its third, not in its second stage.

Thus we have to consider the following forms :—

- I. TUBAL — **Interstitial**, **Ampullary**, **Infundibular** — Through rupture these become
  - Secondary **Tubo-peritoneal** (Abdominal)
  - **Sub-peritoneo-pelvic** (* Extra-peritoneal) (* Intra-ligamentous)
    - Through growth this becomes **sub-peritoneo-abdominal.**
    - Through rupture into peritoneum this becomes in its third stage **tubo-peritoneal** or abdominal.
- II. OVARIAN
- III. PRIMARY ABDOMINAL or Peritoneal

} Hypothetical.

* These are bad names, as unruptured tubes are both extra-peritoneal and intra-ligamentous.

The patient may die of shock or haemorrhage soon after a rupture, or later of peritonitis set up by the escape of blood and other matter into the peritoneal cavity. The foetus may die at any time, when it may be absorbed along

with the other contents of the gestation sac, or **suppuration** may occur in the sac, resulting in the formation of a pelvic abscess. This may open into the vagina, bladder, rectum, or large intestine, or through the abdominal wall to the exterior. Pus, debris of the ovum and bones of the foetus may be expelled by any of these routes, and after a long time the emptied sac will shrink, granulate, and heal up. The mother may die of local or general peritonitis, or may succumb under the effects of prolonged suppuration.

If the dead foetus be not absorbed or expelled from an abscess by suppuration, it is retained in the gestation sac, and undergoes one of three changes. It may shrink and dry up, the organs retaining more or less their form and structure; this is known as **mummification**. A more moist condition allows of changes like those seen in corpses left in water, the fatty parts first, and the others later, being turned into a soap-like mass of yellow colour called **adipocere**. Thirdly, the foetus may be infiltrated with salts of lime, but it is more usual for calcification to occur in the sac, membranes and placenta forming a hard stone-like mass or **lithopaedion**. Inflammation and suppuration may at any time be set up round a dead and altered foetus, but many years may pass without the occurrence of any such change.

The placenta has in many cases been said to grow after the death of the foetus; Berry Hart [1] and Webster [2] deny, however, that there is any proof of this. The increase in size of the placenta which occurs after the death of the foetus is shown by them to be due to extravasation into the organ of maternal blood, which, after clotting, becomes organised, turning the placenta into a mass of connective tissue. On examining sections of the mass, the villi are found widely separated by blood clot in varying stages of organisation. The epithelium of the villi is degenerated

[1] Selected Papers, chap. xx. [2] Ectopic Pregnancy, p. 101.

into a hyaline layer, and haematoidin crystals are scattered irregularly throughout the section. (See Fig. 14.)

Causes.

Any cause preventing the passage of the ovum into the uterus has been thought capable of producing ectopic gestation. Such causes are tumours, peritonitic bands, kinks, indeed anything which constricts the lumen of the tube, or adhesions and inflammations which prevent the peristaltic movement of its walls. If we allow that these causes alone can produce ectopic gestation, we must grant that fertilisation can occur in the tube, and that the ovum can graft itself on healthy tubal mucosa. Lawson Tait believes that fertilisation does not occur in the tube normally, but only when disease has destroyed the action of the cilia of the tubal epithelium, as he holds that downward ciliary action usually prevents spermatozoa from entering the tubes. Berry Hart and Lawson Tait both hold the view that the human ovum can only graft itself on connective tissue, and that the normal site for its implantation is within the cavity of the corpus uteri, because here alone the mucous membrane is denuded of its epithelium periodically by menstruation. They thus consider that the ovum can become implanted in the tube only when the tubal epithelium has been removed by tubal disease. Thus Tait and Hart both hold that tubal disease goes before tubal pregnancy. Bland Sutton and Martin of Berlin hold that pregnancy can occur in a healthy tube, because there are cases in which no trace of inflammation can be found in a pregnant tube, and because tubal pregnancy is seen in women with no history of tubal or other pelvic disease.

Webster,[1] in a recent monograph, takes the view that a certain decidual reaction of the mucosa to the fertilised ovum is necessary for the implantation of the ovum, and

[1] Ectopic Pregnancy, Edin., 1893, p. 10.

that this reaction occurs normally only in the mucosa of the corpus uteri. But uterus and tube are both derived from the Müllerian duct, and in lower mammals decidual reaction can occur and ova can be normally implanted in a larger portion of the oviduct than that represented in the human uterus. Webster therefore holds that, by some developmental error, whereby there is reversion to an earlier stage in mammalian evolution, an unduly large portion of the oviduct may show decidual reaction. In other words, instead of saying, like Hart and Tait, that the ovum can graft only on connective tissue, Webster says that the ovum can graft only on mucosa which shows decidual reaction, that this is normal in the corpus uteri, but occurs abnormally in the Fallopian tubes.

Tubal disease is doubtless a precursor in most cases, and it is this which accounts for the period of sterility which so often precedes ex-uterine foetation. It seems natural, however, that just as uterine pregnancy can occur without any previous denudation of the mucosa by menstruation, extra-uterine pregnancy may sometimes begin without any previous removal of the tubal epithelium by disease.

Forms of Tubal Pregnancy.

The ovum may be implanted in any part of the tube, and as it is needless in this connection to distinguish between isthmus and ampulla, we consider three forms—Interstitial, Ampullary, and Infundibular.

Interstitial.—Grafting of the ovum in that portion of the tube which is embedded in the uterine wall is excessively rare. Specimens are distinguishable from cornual pregnancy because the sac is part of and is embedded in the uterine wall, though they differ from other tubal specimens in that the sac is opposite to instead of external to the insertion of the round ligament. Interstitial pregnancy may progress to full time (Webster), when the foetus may die and remain

in situ. Usually the sac ruptures into the peritoneal cavity before the fifth month, but later than sacs in other parts of the tube. The haemorrhage is great, due to the vascularity of the uterine wall, and the result is generally fatal. Occasionally there is rupture into the uterine cavity, and there may be rupture both into the uterus and into the peritoneum, the foetus entering one, the placenta the other. It is denied by some and asserted by others that rupture may take place between the layers of the broad ligament.

Ampullary.—The ampulla is the commonest site for implantation of the ovum. In this position the gestation may go on till full time without rupture of the tube. Spurious labour then comes on with death of the foetus. There may be a fatal result to the mother, or the foetus may be retained in the sac in a mummified condition. This form is called persistent tubal gestation.

Rupture usually occurs early into the broad ligament, and may cause the death of the foetus or of the patient. If the gestation progresses we have the form called variously sub-peritoneo-pelvic, intra-ligamentous or tubo-ligamentous, and which, as it rises into the abdomen, is also called sub-peritoneo-abdominal. This form is extra-peritoneal throughout, as also is the persistent tubal form. As an extra-peritoneal gestation advances it lifts the peritoneum from the pelvic floor, and pushes upwards the viscera. Hart[1] points out that if the placenta be above and the foetus below, the placenta is raised gradually as much as ten inches, and thus has its blood supply gradually cut off, while successive haemorrhages occur into its substance. This finally kills the foetus, and then, as the dead tissues are near to the rectum, septic absorption from that organ is very likely to cause the formation of abscess. If, on the other hand, the placenta is below the foetus, it remains *in situ*, and forms attachments all over the pelvic floor. The blood supply of the placenta thus is not interfered with,

[1] Selected Papers, p. 162.

as the sac containing the foetus grows upward, and under these circumstances the gestation is much more likely to go

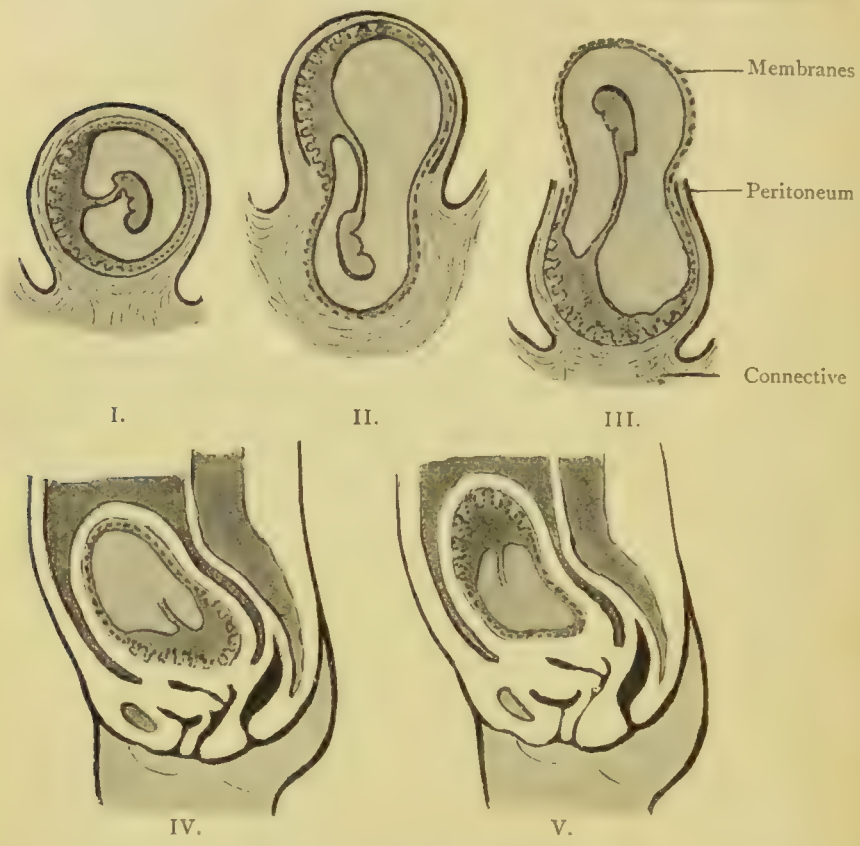


FIG. 15.—Diagrams of Ampullary Gestation, being transverse sections of the tube and the distended broad ligament.

I. Gestation sac in the unruptured tube.

II. Rupture into connective tissue, ovum partly in the tube and partly in pelvic connective. The sub-peritoneo-pelvic or extra-peritoneal form.

III. Rupture through peritoneum into peritoneal cavity, the ovum partly in the tube and partly in the abdominal cavity. The Tubo-peritoneal form.

IV. and V. Show sub-peritoneo-pelvic forms advanced to become sub-peritoneo-abdominal. In IV. the placenta is below and gestation may continue; in V. the placenta is above, and suppuration is likely to occur. IV. and V. thus illustrate Hart's important work on this form.

on to full time. At any time a secondary rupture may occur through the peritoneum, the foetus escaping into the peritoneal cavity, the placenta remaining attached.

If the primary rupture involve the peritoneum, the placenta remains in the tube attached to its original site, the foetus, usually enclosed in its own membranes, escaping into the peritoneal cavity. Webster has proved that this occurs, previously it was considered logically possible. Thus arises the form of gestation called tubo-peritoneal or secondary abdominal. The escape of the foetus may also occur through the dilated end of the tube, with the same result. The gestation may continue, a secondary sac lined by the amnion being formed in the peritoneal cavity. Leopold has shown that foetuses put directly into the peritoneal cavity are quickly absorbed. It is therefore probable that a foetus escaping from a tubal sac into the peritoneum, uncovered by amnion at least, cannot continue to develope. Nor is it now considered possible that a developing ovum can escape complete from a ruptured tube and graft itself afresh on the peritoneum. Tubo-peritoneal gestation may terminate in death of the patient from shock, haemorrhage, peritonitis or prolonged suppuration. Haematoecle may be absorbed, the foetus may be discharged by suppuration or retained mummified, turned to adipocere or lithopaedion as in extra-peritoneal gestation.

Ampullary gestation may thus go on to full time without rupture; may rupture into the broad ligament, or into the peritoneal cavity. In either case gestation may continue or may terminate in any of the usual ways. Lastly, ampullary gestation may end at an early stage before any rupture has occurred. The foetus may die and be absorbed, or be retained in a mummified or other condition. Blood may be effused into the tube giving haematosalpinx, which may be absorbed or may suppurate, giving pyosalpinx. Tubal abortion is the term applied to cases where the ovum perishes and escapes through the dilated fimbriated end of the tube into the abdominal cavity. A fleshy mole may be formed in the tube by the organisation of blood effused into the ovum, and may be long retained.

Infundibular.—Grafting of an ovum in the infundibular end of the tube is very rare. It may occur in the end of an accessory tube and perhaps in a hollow ovarian fimbria. An ovum so grafted easily passes partially into the peritoneal cavity. Adhesions are formed between the membranes and various viscera, a sac being formed which is not apparently of tubal origin. Thus originate some forms which are strictly tubo-peritoneal or secondary abdominal.

Ovarian and Primary Abdominal Pregnancy.

Going still further from the uterine cavity we find described forms of ectopic gestation called primary abdominal and ovarian, in which the fertilised ovum is said to become grafted on the peritoneum or on the wall of a Graafian follicle. Most of the cases are very old, and were described when knowledge of development and placental formation was far from its present condition. These cases have been handed down by tradition, and are now of interest only as forming a part of the history of mistakes. The recently used method of investigation by frozen sections of the whole body has thrown new light on the subject, and even recent cases that have not been critically examined by recent methods should not be taken as evidence. Bland Sutton, Lawson Tait, Hart and, recently, Webster, all deny the occurrence of primary abdominal or of ovarian gestation. In many cases the ovary is incorporated with the wall of the sac and flattened out so as to be unrecognisable as an organ, so that the presence of ovarian tissue in the sac wall affords no proof whatever that gestation commenced in the ovary.

Symptoms and Signs.

The first symptom of extra-uterine pregnancy is usually amenorrhoea. Pain in the pelvis begins in two or three months, and is often severe. There may be escape of blood

from the uterus, which is mistaken for the recommencement of menstruation. The shedding of a decidual cast of the uterus usually occurs only on the death of the foetus. If a sudden rupture occur, the patient suffers from shock, and presents the symptoms of haemorrhage, collapse, fainting, pallor, and absence of pulsation. Such attacks may occur again and again; and as pregnancy advances, the usual signs and symptoms appear, including abdominal tumour, with foetal movements and heart sounds. If pregnancy continue to full time, a spurious labour occurs, usually without rupture of the sac; but the foetus dies, and a decidual cast of the uterus is expelled. The uterus is now 4 to 7 in. long, and is soft like a puerperal uterus; the decidua is about $\frac{1}{4}$ in. thick, contains decidual cells, and consists of a compact layer and a spongy layer, through which separation takes place. After the false labour, the tumour gets smaller through absorption of the liquor amnii and shrinking of the foetus. No further symptoms need occur, unless inflammatory changes are set up by the retained foetus.

The earliest signs are enlargement of the uterus, and the presence of a swelling at one side of it in the position of a tube.

If rupture occur, the lateral swelling may be noticed to disappear, being replaced by a pelvic haematocele. Later, the uterus is pushed to one side, and may ultimately form a portion of the gestation sac. The tumour gradually rises into the abdomen, occupying a lateral position usually, though the sac may develop almost in the middle line behind the uterus, which is then pushed upwards and forwards. The bladder may be found in any position, and its functions may be interfered with seriously. Similarly, the rectum may be much displaced and pressed upon. Diarrhoea may occur, in which the stools are blood-stained when the placenta has formed attachments to the bowel, and thus rendered it unduly vascular.

Suppuration in the gestation sac may give the signs and symptoms of acute septicaemia, but oftener the process is limited and chronic, ending in discharge from an abscess of the products of conception.

Absorption of the dead ovum, haematoma, or haematocele, is accompanied by gradual disappearance of both symptoms and signs.

Retention of the mummified or calcified ovum is marked by the subsidence of symptoms, with the persistence of the tumour, somewhat reduced in size.

Diagnosis.

Extra-uterine pregnancy must always be diagnosed by careful physical examination, preferably under an anaesthetic. The pelvis should be explored from both vagina and rectum with one hand, while the other hand palpates through the abdominal wall. Pregnancy must be proved to exist, and the presence of a swelling other than the uterus must be demonstrated. It is useful to bear in mind the following conditions:—

1. **Uterine pregnancy.**—Given an enlarged uterus, a lateral swelling, and the symptoms of pregnancy, we may have (1) ectopic gestation; (2) uterine gestation, with a swelling not due to ectopic gestation; or (3) uterine gestation and ectopic gestation. Great care is necessary, and Webster holds that it is justifiable to examine the interior of the uterus with sound and curette, examining the scrapings microscopically for decidual cells, as he considers that the risk of interrupting a uterine pregnancy is less than that of leaving undiagnosed an ectopic one.

2. **Retroversion** of the gravid uterus at an early stage may be confused with the development of an ectopic sac behind the uterus. The characteristic history of rectum and bladder trouble will usually identify retroversion. Later, after rupture has occurred, the history will point to ectopic gestation.

3. **Small ovarian** and broad ligament cysts cause no signs or symptoms of pregnancy. Large ones cause irregular menstruation, but are easily distinguished from a pregnancy in progress. They may simulate more closely a dead incarcerated foetus, as rupture or torsion of the pedicle may give symptoms like rupture of a gestation sac or spurious labour. The uterus, however, is not enlarged as in ectopic gestation, and it never forms part of the wall of a tumour.

4. **Fibroids** cause menorrhagia, grow slowly, and cause no symptoms of pregnancy, but may closely simulate a retained and altered foetus. The history usually distinguishes the conditions.

5. **Haematoma** and Haematocele in the pelvis may occur apart from the rupture of tubal gestations. If it is possible to determine by the symptoms and signs that pregnancy has been present, it is necessary to operate, while haematoma and haematocele from other causes may be left alone. The point is therefore important. In cases seen some time after the haemorrhage it is impossible and unnecessary to make the diagnosis, as no operation is called for.

7. **Inflammatory swellings** in the pelvis are distinguished by the temperature and absence of signs of pregnancy from ectopic gestation in progress. The examination of discharges naturally or surgically evacuated from abscesses may prove these to have had their origin in ectopic pregnancy.

8. **Malignant disease** should be recognised by history, absence of the signs of pregnancy, rate of progress, and cachexia. It may simulate a dead retained foetus.

9. **Pregnancy** in a **rudimentary uterine horn** cannot be distinguished from tubal pregnancy till the specimen is seen, unless the existence of the malformation is previously known. The presence of a vaginal septum or of a double os uteri may indicate that pregnancy is in the horn of a bicornuous uterus.

10. **Spurious pregnancy** can be distinguished from ectopic on examination under an anaesthetic.

Prognosis.

This is always bad while the gestation continues, as a fatal rupture is liable to occur. If the foetus be dead there is probability of acute or chronic suppuration, and this is always possible though the foetus may have been incarcerated for a long time. Given that the foetus is dead and is not too large, it may be completely absorbed, and no evil result need be feared after it is ascertained that the process of absorption is progressing favourably. If seen and operated upon early, there is no reason why any case should be fatal.

Treatment.

If the diagnosis is made **before any rupture** has taken place it is usual to open the abdomen in the middle line, and remove the tube whole. The growing popularity of colpotomy may modify the treatment at this stage, as it is found that by separating the bladder from the uterus, and entering the peritoneal cavity between them, the patient receives much less shock than in abdominal section. Dr Donald of Manchester recently removed an unruptured tubal gestation by this method with complete success. The operation has had favourable results abroad in the same condition.

If the patient is seen **just after rupture** it is usual to open the abdomen as soon as possible—the better to deal with haemorrhage and clean the peritoneal cavity. The tube is removed if possible. It may be necessary to wait till the immediate effects of shock and bleeding have passed before attempting the operation. Ruptures causing marked symptoms, but not seen for some time, must be treated in the same way.

If a rupture cause slight symptoms which soon pass off, it is usual to wait and observe the swelling, using the treatment appropriate for pelvic haematocele or haematoma.

If the foetus be dead, absorption may now occur, but if not, the sac continues to grow, and as further rupture may occur with disastrous results, operative interference must be undertaken.

When gestation is so far **advanced** that the sac cannot be removed whole, the best treatment is to sew its walls to the abdominal wound after removing the foetus and blood clot. The sac can then be plugged with iodoform gauze, which controls bleeding and can be left *in situ* for five or six days. The placenta can then be removed without causing the profuse haemorrhage which occurs if the placenta is removed at the time of the operation. The reason for this is, that the placenta is spread over a large surface which cannot rapidly contract and cut off its blood supply like the muscular wall of the uterus. In a few days, however, thrombosis and organisation of clot blocks the vessels, after which the placental tissue can be removed piecemeal with comparative safety. As alternatives, the placenta can be removed at the operation, the sac being sewn up or drained through the abdominal wound, or the placenta may be left *in situ* to absorb. These methods risk respectively haemorrhage and sepsis, so it is best in most cases to remove the placenta later, and after its removal to pack the cavity again with gauze. In advanced cases it is usually possible, by making the incision where the sac is in contact with the abdominal wall, to avoid entering the peritoneal cavity at all. For this reason a lateral incision should be used on the side on which the sac rises highest. The incision should be as low as it conveniently can be, and if possible it should avoid the placenta. The cavity should be kept packed with iodoform gauze, changed frequently, until it contracts and closes. The placenta should not be removed till four or five days have passed.

When the gestation has nearly reached **full time**, some advise waiting till spurious labour has occurred. The only advantage thus gained is that, the child being dead and

placental circulation stopped, the placenta can be separated more safely. But it is probably better to operate without waiting—remove the child alive, and leave the placenta to be separated later.

When a **dead child** is retained, even if it is mummified or calcified, it is safest removed, so an operation should be undertaken.

Suppurating sacs should be treated as usual, by giving free drainage and evacuating them as completely as possible. Those bulging into the vagina can very satisfactorily be opened through its wall and plugged with gauze. It may be necessary to open some through the abdominal wall, avoiding the peritoneum. Natural openings in the vagina and to the exterior may be enlarged, and if the sac has burst into bladder or rectum, an additional free opening should be made into the vagina or to the exterior, so as to hasten the progress of cure.

There are many operators who prefer opening the sac by the vagina to the abdominal method in both early and advanced cases of extra-uterine pregnancy, because they claim that there is less shock, and less risk of entering the peritoneal cavity. The vaginal opening, however, is less favourable for dealing with haemorrhage than the abdominal, and it exposes the patient to a greater risk of sepsis. Doubtless many cases may be successfully treated by vaginal incision besides those suppurating cases which point in the vagina, and should clearly be drained through that passage.

The use of an electric current passed through the sac in order to kill the foetus is passing out of favour at present.

The injection of morphia and other drugs into the sac in order to kill the fœtus have passed entirely out of use.

Compression of the gestation sac, aspiration of the liquor amnii, and attempts to kill the foetus by half starving or nearly poisoning the mother are remembered as curiosities of treatment.

CHAPTER IX.

PATHOLOGY OF PREGNANCY—*Continued.*

DISEASES OF THE OVUM.

CHORION.

Vesicular degeneration.—This condition is also called herpigenous degeneration of the chorion and hydatid mole. The villi of the chorion undergo myxomatous degeneration and proliferation. Upon them are formed numberless small pedunculated cysts filled with mucous fluid. The change sometimes begins early, the whole chorion being affected; in other cases only the chorion frondosum is altered, the change being of later date. A similar degeneration beginning still later may affect only a portion of the placenta, pregnancy ending at full time with the birth of a living foetus. The cysts, which may be as large as a gooseberry, are arranged in strings, and are dilatations in the course and at the ends of the villous branches. The cause of this condition is apparently foetal, as in multiple pregnancy one ovum may form a hydatid mole, the other developing normally. As a rule no trace of a foetus is found, but in cases of late origin some portions of the embryo may resist absorption. The mass is usually expelled before the fifth month, but is occasionally retained thirteen or fourteen months.

Symptoms.—A free watery discharge often occurs at the third or fourth month, the fluid often being yellow or blood-stained. The uterus is found to be larger than it should be at a corresponding date in normal pregnancy, and it con-

tinues to grow with undue rapidity. Sickness, turbidity of the breasts and other symptoms of pregnancy appear. Clusters of vesicles with sanguineous discharge may be expelled, and are often said to look like white currants floating in red currant jelly. The whole mass is usually expelled naturally after the symptoms of abortion.

Diagnosis.—The discharge will suggest a physical examination. The large size of the uterus will then be noted. The surface of the uterus is irregular, there is no fluctuation, no foetal heart, no ballottement; but a sort of crepitating feeling. If the os be patulous a finger introduced may receive the sensation felt on touching placenta. On waiting a few days the rapid growth of the uterus can be noted, and the expulsion of vesicles and blood may complete the diagnosis.

Prognosis.—As the mass is usually discharged whole before the fifth month, the prognosis is fairly good. The vesicles eat their way into the uterine wall, injuring it and sometimes penetrating nearly to the serous surface. There is thus a tendency to profuse haemorrhage at the separation of the mass, with a predisposition to sepsis. Involution is apt to be slow and imperfect. The prognosis is, however, impaired by the fact that several cases are reported in which the removal of hydatid mole has been followed by malignant disease of the corpus uteri, and in which there was reason to believe that the cells of the new growth were of chorionic origin. There is still some uncertainty about the origin and nature of the so-called malignant deciduoma.[1] The cells of this new growth are said to be sarcomatous, and are supposed to be derived from the decidual cells, which are, of course, known to be derived from connective tissue cells of the decidua. It is considered, however, by many authorities that malignant

[1] Described by Sänger, 1888. Copious literature since. Grave doubt remains as to whether the new growths in uterus and other organs are derived either from decidual cells or from foetal epiblast, so that they may not be due to pregnancy at all.

deciduoma is really an epitheliomatous growth, the cells being derived from the foetal epithelium of the villi.

Treatment.—The uterus must be emptied. A tent may be used, followed, if necessary, by hydrostatic dilators, the uterus then being allowed to expel its contents. Such gradual methods of emptying the uterus give less risk of haemorrhage, but more risk of sepsis, than rapid dilatation under anaesthesia, followed at once by manual removal of the mass. In either case the uterine cavity should be thoroughly scraped out with the fingers or a curette, and then washed out with a hot astringent and antiseptic lotion. The cavity may be plugged with gauze if necessary. Ergot may well be administered after the uterus is empty. Though it is frequently given earlier to aid the expulsion of the mass, the result is often contraction of the cervix, which, of course, hinders evacuation. The uterus must be watched during involution. The patient should be kept in bed longer than after abortion, and may take iron and ergot continuously in small doses. Hot vaginal douches are also of great use. Iodine may be applied to the endometrium at suitable intervals.

Myxoma.—A diffused myxomatous degeneration of the chorion found in some abortions needs no special description.

Amnion.

Deficiency of liquor amnii is occasionally met with. If the amnion be not in good time distended with fluid, adhesions are apt to occur between the membrane and the foetus, impeding the growth of the latter and causing various deformities. This is often seen in ectopic gestation. Later in pregnancy, absence of the full quantity of liquor amnii is of no moment, provided that there is enough to form the dilating "bag of waters," without which labour is apt to be tedious.

Hydramnios, also called Polyhydramnios and Hydrops Amnii.—The quantity of liquor amnii may be from two

quarts to six gallons. The condition occurs once in about 150 cases, and five times oftener in multiparae than in primiparae. The liquor amnii often begins to increase gradually at the third or fourth month, but it may rapidly become excessive at about the sixth month. The source of the condition is said to be excessive secretion by the amnion and the amniotic surface of the placenta. It is associated with disease of the placenta and membranes, and is frequently seen with uniovular twins. The cause is probably some obstruction in the foetal circulation.

The over-large uterus causes great sickness and pressure symptoms including oedema of the legs and vulva. It may be noted that other causes of oedema do not cause hydramnios. The large uterus is globular and gives unusually perfect fluctuation. The heart sounds are heard with difficulty or not at all. Ballottement reveals the presence of the foetus.

The distension, perfect fluctuation and absence of heart sounds may suggest parovarian cyst, but ballottement and the signs of pregnancy will correct the diagnosis. The large size of the uterus at an early stage may suggest hydatid mole, but the fluctuation will negative this. Ovarian or parovarian tumour complicating pregnancy may present a difficult point; the most valuable information will be got by waiting to feel uterine contractions. A distended bladder has been mistaken for hydramnois as, for other fluctuating abdominal tumours.

Half the cases of hydramnios end in premature labour. Irregular presentations and positions are frequent. The foetus is often dead and frequently macerated. Labour at full time is tedious, the over-distension preventing the head from engaging, causing mal-presentations and impeding the uterine action.

Diuretics may be of advantage, and the wearing of a bandage or suitable belt may relieve the patient as pregnancy advances. If the child be of viable age, and the

symptoms excessive, premature labour may be induced, the membranes being artifically ruptured when dilatation is advanced to a suitable stage. If the symptoms demand the termination of pregnancy before the child is viable, the membranes may be punctured through the cervix, and expulsion will follow.

Placenta.

Myxoma.—The placenta may be the seat of myxomatous and hydatiform degeneration. There may be a living child if enough of the placenta retains its function. In the condition called myxoma fibrosum the chorion is thickened and fibrous, bulging into the maternal tissues, so that it may stop the circulation and destroy the ovum.

Cysts.—Under the amnion, cysts may be found varying in size from that of a pea to a walnut. They contain mucous fluid, and may perhaps owe their origin to extravasations of blood.

Apoplexies.—Effusion of blood may occur into one lobule of the placenta at a time, tearing up the villous substance; clotting and organisation follow, and the lobule is reduced to a scar. Mere coagulation of blood in a lobule produces the same result. This occurs first in one lobule and then in another, till ultimately the circulation is so impaired that the foetus dies. On examining the placenta various apoplectic lobules are found, some recent, the blood merely clotted; others older, organised and decolourised fibrin, the villi compressed, and their epithelium degenerated. Lobules destroyed still earlier are reduced to mere scars of fibrous tissue. The causes of this condition are not understood. It occurs oftenest in syphilis, but also with albuminuria and other conditions. Iron, quinine, and digitalis may be given in the next pregnancy to improve the circulation, and potassium chlorate given in frequent small doses throughout is said to have an excellent effect.

Carneous Mole.—This is also called sarcous or fleshy

mole, sometimes also it is termed apoplectic ovum. The embryo may be absorbed, or traces of it may remain; the amniotic cavity may partly or wholly disappear, but the ovum is retained in utero, it may be for months. Organisation of effused blood forms a fibrous mass, and repeated effusions may add to its size and simulate growth of the ovum. The villi rapidly degenerate and lose their epithelium, and are easily distinguishable from the villi in fresh placenta. There is often difficulty in diagnosis, for after two or three months of amenorrhoea a bleeding often occurs, and is easily mistaken for an abortion by the patient. Then follows amenorrhoea for several months, and it may be thought that pregnancy is going on, and that the bleeding was only a threatening of abortion. The uterus is then found to be enlarged, but not to a degree corresponding to the supposed duration of pregnancy, and it may now be thought that a complete abortion did occur at the bleeding mentioned, and that the patient is again pregnant. The mole is finally discharged after the symptoms of abortion. The condition is one of *missed abortion*, and its treatment is discussed under that heading. *Blighted ovum* is a similar condition, but with less effusion of blood and thickening of the tissues, the ovum being shrivelled.

Oedema.—The placenta is large and heavy and contains semi-serous fluid in some conditions of obstruction to the foetal circulation, and from some maternal causes. This may cause the death of the foetus and premature labour.

Congestion.—The placenta may be hyperaemic from a too high maternal blood pressure or congested from imperfect venous return. This state may be followed by inflammation.

Inflammation.—Inflammatory changes doubtless begin in the foetal portion of the placenta, causing overgrowth of connective tissue and undue toughness of the organ. These changes may affect the decidua, rendering its spongy layer too firm, and causing adherent placenta, though the causes of this are probably mostly maternal. Inflammatory pro-

ducts may be found on the maternal surface. The connective tissue of the villi is increased in quantity and the walls of their vessels are thickened. In the epithelium of the villi cloudy swelling is followed by degeneration.

Calcareous deposits.—The maternal surface of the placenta is often studded with calcareous deposits, which are seen to begin where the tips of the villi meet the decidua. They do not cause adherent placenta or any other trouble. Salts of lime are also sometimes deposited in the vessels of the villi.

Fatty degeneration.—This change may occur irregularly without causing the death of the foetus. Though it may cause haemorrhage and abortion. When a dead foetus is retained for some time it affects the whole placenta.

Abnormalities.—Peculiarities in form, size and situation of the placenta have been mentioned in the description of the healthy organ, as they cause no functional disturbance during pregnancy, with the exception of placenta praevia, which will be treated as a complication of labour with accidental haemorrhage.

Cord.

Abnormalities of structure have been mentioned in describing the healthy cord. Knots and excessive torsion endanger the life of the foetus, as they may arrest the circulation. The vessels of the cord suffer in syphilis and other intra-uterine diseases. Coils of the cord may cause difficulty in labour, may strangle the foetus, and may, it is said, even cause intra-uterine amputation of limbs.

Foetus.

Rickets.—Some authorities do not allow that ordinary "rickets" occurs in utero. There is, however, a condition, whose cause is obscure, which closely resembles this disease. It is not caused by mal-nutrition of the mother. The mineral elements in the bones are deficient. There

may be fractures, united or ununited. Ossification is imperfect, and the ends of the long bones are thickened. The head is large, and the pelvis may be flat instead of having the relatively long conjugate of the healthy foetal pelvis. The abdomen is swelled and the liver is enlarged.

Syphilis.—The manifestations of intra-uterine syphilis are numerous. The skin shows copper-coloured stains and blotches, flakes of epidermis are often detached, and if the foetus is retained dead in utero the skin peels off extensively. Pemphigus of the soles and palms occurs, condylomata may be found, there may be cracks round the mouth, and mucous patches are usual. Chronic peritonitis produces flaky lymphatic deposits amongst the viscera. In the liver, thymus, spleen, pancreas and lungs there is overgrowth of fibrous tissue with the formation of small gummata. Osteo-chondrosis syphilitica is the term applied to inflammatory changes at the junction between the shaft and the epiphysis in long bones. A section through the head of the femur or humerus shows a band of yellow colour in place of the usual linear junction. There is proliferation of the cartilage cells, followed by calcareous infiltration, and, it may be, by caseous change which separates the epiphysis completely. This is a most valuable point in the diagnosis of syphilis when a history cannot be obtained.

Zymotics.—The child is often killed by high temperature without itself acquiring the disease from which the mother is suffering; or it may die of the disease itself. The normal placenta is probably a good germ filter, but when injured by disease it may easily lose this function. The toxic products of the life of pathogenic organisms can doubtless pass into the foetal circulation with greater ease than can the organisms themselves.

Neoplasms and Malformations.—Various new growths develope in utero, and the numerous deformities and malformations which may occur are well known. It is needless to enumerate these, or the various terratomata which are

met with. During pregnancy these conditions are not diagnosed, and those of them that cause difficulty in labour will be discussed later.

Death of the Foetus.—The numerous causes which may bring about death of the foetus in utero need not be enumerated here, as they have been referred to in their proper places. A dead foetus is, as a rule, expelled within about three weeks of its death. Death of the foetus is diagnosed by cessation of the symptoms of pregnancy. The breasts become flaccid and shrink. Growth of the uterus ceases, and the abdominal tumour diminishes somewhat. Prolonged absence of foetal movements, and of the foetal heart-sounds when these have previously been recognised with ease, are valuable negative signs. If it is certain that death has occurred, and offensive discharge occurs before natural expulsion begins, labour should be artificially started.

Maceration.—Septic organisms do not easily gain access to the interior of the uterus; air is not easily admitted; but moisture is abundant. The dead foetus loses its elasticity. The skin peels off, and, if expulsion be long delayed, maceration of all the tissues goes on till the whole is reduced to a bag of bones. At labour under these circumstances the presentation is likely to be irregular.

Mummification is a dryer process, seen in some ectopic pregnancies and in the case of a dead foetus in multiple pregnancy. One foetus continues to develope, the other being retained shrivelled and flattened by pressure. At labour it is expelled in a parchment-like condition—a so-called papyraceous foetus.

Calcification has been referred to under "Ectopic gestation." It is also termed petrifaction and lithopaedion formation.

Missed Labour.—This term refers to cases in which parturition has been delayed indefinitely after the death of the foetus at an advanced period of gestation, with or without the occurrence of a false labour. Such cases doubtless

occur amongst domestic animals. One of the most recently reported is that of a basset hound bitch who gave birth to some dead puppies in May, recovered her health, and was served in December while "on heat." She died of peritonitis in January, and an incarcerated puppy was found in the uterus, which thus must have been retained seven months after the birth of the rest of the litter. Many of the cases reported in the human species are doubtless instances of incarceration after gestation in a tube or the horn of an abnormal uterus. Some of them may have been genuine uterine pregnancies.

INTERRUPTED GESTATION.

The terms "abortion" and "miscarriage" are applied to the interruption of pregnancy before the foetus has reached a viable age, after this the interruption is termed "premature labour." Gestation is said to be interrupted in about one case in seven, some authorities even stating that one fifth of all pregnancies are abortive. Thirty-seven per cent. of child-bearing women are said to abort once at least before the age of thirty-one, and after this age the occurrence is still more common. Many early abortions are never recognised, the ovum escaping in fragments with haemorrhage, which is taken for a delayed menstrual flow. Abortions tend to occur at times corresponding to menstrual periods, most frequently the third or fourth. Thus abortion is commonest during the third and fourth months of pregnancy, when the decidua is more vascular and the placenta less developed than later. Primiparae abort less frequently than multiparae.

Causes.

Foetal causes of abortion are disease of the chorion, amnion, placenta or cord; sudden loss of liquor amnii; malformations or defects causing death of the foetus.

Maternal causes due to morbid conditions in the mother may be enumerated as follows:—(1) Febrile conditions, with high temperature and specific toxins in the blood; (2) syphilis; (3) serious disease of the alimentary, respiratory, circulatory, nervous or urinary systems; (4) uterine congestion, disease, or displacement; (5) neoplasms of uterus and pelvic organs.

Accidental.—But abortion frequently occurs in women whose pregnancy presents no pathological features, and in whom the causes are of the nature of separable accidents. Some of these extraneous causes act through the nervous system, and such include the passions and emotions, however aroused, with all forms of mental shock. Others are physical in their nature, and may result from riding, dancing, and rough driving, or from falls and other accidents. Excesses in food, drink, or exercise, and late hours in crowded rooms are also followed by abortion. Criminal abortion is usually *procured* by the introduction of some instrument into the uterine cavity, though it is doubtless more frequently *attempted* by administering various drugs. Cathartics, cantharides, savin, iron, quinine, and ergot are amongst the drugs most frequently employed: but no drug will cause abortion where there is no tendency to it, unless given in sufficient doses to produce a powerful toxic effect upon the patient. In other words, drugs administered with a view of producing abortion are almost as likely to kill the mother as to expel the foetus. Many women have a habit of aborting, which they do time after time without apparent cause. In some the sight of a mouse or the extraction of a tooth may cause expulsion of the ovum, while others may suffer accidents causing fracture of limbs and other serious results, or may undergo major operations, including the removal of ovarian and other pelvic tumours, without any interference with pregnancy. A sound may be introduced into the early pregnant uterus, though not so as to puncture the ovum, without causing abortion, while a hot vaginal douche may be sufficient to do so.

The common **paternal** cause of abortion is syphilis, but extreme youth or age of the male parent, and other constitutional conditions, are unfavourable to the completion of gestation. This is seen amongst the domestic animals, as cows served by an exhausted bull frequently abort early.

Symptoms.

Pain in the pelvis is usually intermittent, and is likened to early pains of labour or to dysmenorrhoea. Bleeding may only appear after uterine contraction has separated some portion of the ovum, but it may begin before any pain is felt if it is a cause and not a result of the aborting process. Blood may be retained, distending the uterus; the serum may flow away, the clots being expelled later; or clots and serum may be expelled during the pains. Thus the bleeding in abortion may closely resemble a menstrual flow, or it may be intermittent, recurring at intervals of several hours or of days. The haemorrhage is seldom profuse and may be very slight. The cervix is more or less dilated.

Varieties.

Threatened Abortion.—When the pains are irregular and allow considerable periods of respite, the bleeding being small in amount and the os being only slightly dilated, the condition is known as threatened abortion.

Inevitable Abortion.—If the attacks of pain are more violent and prolonged, the bleeding more severe and continuous, and the os so much dilated that the ovum can be felt through it with a finger, it is recognised that the ovum cannot fail to be expelled, and the term inevitable abortion is applicable.

Complete Abortion.—To understand the process of abortion at any stage it is necessary to remember that the uterine cavity is lined by decidua in which a spongy layer is present, through which separation should take place.

It must also be remembered that the decidua vera does not unite with the decidua reflexa until after the first three months of pregnancy.

In a complete abortion all within the spongy layer of the decidua must come away, that is the decidua vera, reflexa and serotina, the membranes and placenta, and the foetus.

Incomplete Abortion.—An abortion is incomplete if any of these structures remain in utero, and there are several degrees of incompleteness. For example, the foetus may come away, leaving the membranes, placenta and decidua *in situ*. Before the union of reflexa and vera, the ovum may come away with the reflexa, leaving the deciduae vera and serotina *in situ*, and this may easily be mistaken on cursory examination for a complete abortion. After the union of reflexa and vera it is common for the foetus to escape with the membranes and deciduae reflexa and vera, leaving the placenta *in situ*. While any portion of the placenta or deciduae remains in utero the abortion is incomplete. Portions so left may come away piecemeal with the normal discharges, or may become septic and set up acute or chronic infective disease, with offensive discharge and other symptoms. Sometimes a remnant remains firmly attached to the uterine wall and forms a so-called placental polypus,[1] which is a mass of connective tissue, formed from organised blood clot, containing compressed and degenerated villi.

Missed Abortion.—An ovum may perish, and instead of being expelled, may remain in utero for weeks or months.[2]

[1] Some of the cases of so-called deciduoma malignum are described as occurring after placental polypus. See Doran, Vol. xxxvii. Trans. Obs. Soc.

[2] The case of "Kitson *v.* Playfair" arose about an abortion which was completed on 23rd February 1894. The substance then removed from the uterus was held by Dr Playfair to be a piece of fresh placenta left in utero after a recent incomplete abortion. On the other hand, it was maintained that the substance removed was the result of conception at least eighteen months before, and was part of a blighted ovum which was said to have perished, with haemorrhage, in October 1892, and to have been retained in utero sixteen months.

The symptoms of pregnancy disappear, except amenorrhoea, which may persist. The ovum is ultimately expelled, after the symptoms of abortion, in a shrivelled condition (blighted ovum), or in the form of a fleshy mole. The term *molar abortion* is sometimes used. (See Carneous Mole, p. 155.)

Diagnosis.

When the signs and symptoms of pregnancy are present, and pain, bleeding and dilatation of the cervix occur, the important question is to determine whether abortion is threatened or inevitable.

Threatened or Inevitable?—Three points must be considered. (1) The bleeding:—If this is large in amount, and continues in spite of treatment, or recurs after it has been checked, abortion will follow. (2) The uterine contractions:—If these are frequent and violent, and continue in spite of treatment, abortion will follow. (3) Dilatation of the cervix:—If the finger can be passed into the cervix so as to feel the ovum protruding through the os internum, abortion cannot be averted. This applies only to the earlier months of pregnancy.

Complete or Incomplete?—If the patient be seen only after some mass has been expelled, it is necessary to determine whether abortion is complete or incomplete. There are only two ways of doing this. One way is to see everything that has been expelled, and make sure that not only foetus, membranes and placenta, but also the whole decidual lining of the uterus, has come away. It must be remembered that the early chorion is shaggy all over, but later it is smooth, except where the placenta is developing; that the reflexa gives a smooth covering to the greater part of the ovum till the third month, when it blends with the vera; and that the outer surface of the decidua is formed by the tearing through of its spongy layer, and is therefore irregular, rough, and not covered by any continuous layer of cells.

If the whole ovum and the decidua are obtained, the abortion is proved to be complete. Otherwise the other method must be adopted. This consists in putting a finger into the uterus, and ascertaining, by feeling all over its surface, that nothing remains except the deep layer of the uterine mucosa. If the cervix does not admit the finger, it must be dilated artificially until it will do so. In every case it is the duty of the practitioner to ascertain in one of these two ways whether the abortion is complete or incomplete. It is not sufficient to hear that something has been passed and thrown away, and to note that haemorrhage has ceased and the cervix has contracted.

Diagnosis when missed.—The diagnosis of missed abortion may be difficult. The signs and symptoms of pregnancy may disappear before the patient is seen. Thus an attack of bleeding, with dilatation of the cervix and the projection of a rounded body at the os internum, may be mistaken for the attempted expulsion of a polypoid growth, when it is really the expulsion of a blighted ovum. When there is a clear history of pregnancy and a supposed abortion, followed by a period of amenorrhoea, it may be thought that abortion has been merely threatened, and that pregnancy is continuing. The small size of the uterus will negative this; but it may be thought that a second pregnancy has begun. Under these circumstances it is necessary to wait a few weeks, and note whether the uterus is growing or not. If growth does not occur, missed abortion must be diagnosed. The cervix must now be dilated, and the uterus explored, the diagnosis being confirmed, and treatment being carried out at the same time. There is no advantage in waiting for natural expulsion of the ovum.

Prognosis.

In natural abortion there is little or no danger to life, while criminal abortion frequently ends fatally, owing

to the exhibition of drugs in toxic doses, and the unskilful use of instruments. The risks incurred are haemorrhage and sepsis. Haemorrhage is very seldom severe, and acute sapraemia and septicaemia are unusual. Complete abortion or incomplete abortion early treated only cause subinvolution and displacements through insufficient rest. Incomplete abortion untreated may cause acute septic mischief, but the common results are **chronic infective inflammations** of the uterus, tubes, ovaries, pelvic cellular tissue and pelvic peritoneum. These conditions, following abortion, cause a large portion of the troubles seen by the gynaecologist. They may cause lifelong discomfort and pain, sterility and dangerous conditions like ectopic gestation. Therefore every case of abortion should be treated with as much serious care as if it involved an immediate and grave risk to life. Missed abortion seldom causes acute disease, but after it there is a great tendency to subinvolution and displacement. The possibility of malignant disease of the body of the uterus being inaugurated by chorionic or decidual relics adds a gravity to the prognosis in missed as well as in incomplete abortion.

Treatment.

Prophylactic.—If a woman has aborted on one or two occasions, pregnancy should be prevented from occurring until the cause has been discovered, and something done to remove it. Thus endometritis or endocervicitis should be attended to, or if syphilis is suspected, father and mother should have a course of mercury. When pregnancy occurs again, the anaemic woman should be plied with iron; if placental apoplexy has occurred, the blood should be kept alkaline with frequent doses of potassium chlorate. A displaced uterus should be supported during the early months with a suitable pessary. Coitus should be avoided, especially during the first four months. The

patient should be put to rest at times corresponding to menstrual periods. Purgatives and all excesses should be avoided. Fatigue and all such exercises as riding, dancing and rough driving should be shunned. Baths and vaginal douches should be neither hot nor cold.

Treatment of Threatened Abortion.—If abortion is threatened the patient must be put at rest in bed, and light diet enjoined. Sedatives must be given, the morphia

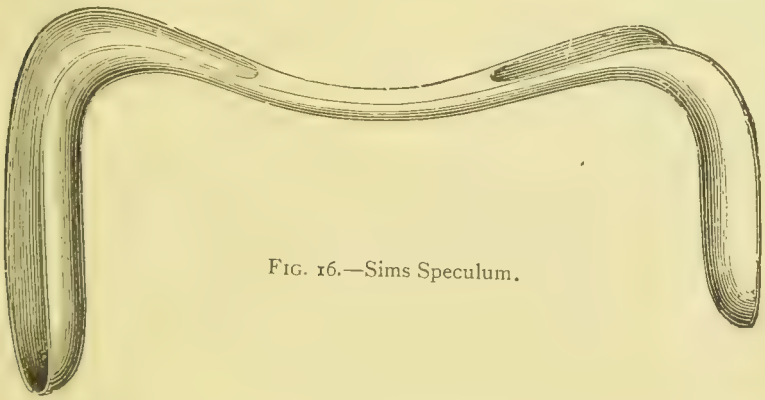


FIG. 16.—Sims Speculum.

suppository being a useful form. Ergot in 10-m. doses thrice daily will give tone to the uterus, but if more be used it may set up expulsive contractions. The liquid extract of Viburnum prunifolium may be given in ʒi doses thrice daily. Bromides may also be used. Purgatives should be replaced by enemata. At the next menstrual period the patient should again be put to bed for a few days.

Treatment of Inevitable Abortion.—When abortion is inevitable there should be no unnecessary interference with the miniature labour which will occur, as the more natural is the process the more likely is it to be complete. If there is much bleeding a hot douche may be given of any antiseptic lotion at a temperature of 115 F. to 120 F. The vagina should then be plugged, using a Sims speculum, with strips of antiseptic gauze, or of any soft textile material torn into strips, and rendered aseptic by boiling or immersion in an antiseptic lotion. The end of every strip

should be left outside the vagina to facilitate removal Ergot may be given in medium doses, say ʒi or ʒi ss. every four or six hours; but there is a risk of causing continuous contraction of the whole uterus, and so preventing expulsion. Many authorities make it a rule never to give ergot while anything remains in the uterus, and then only if haemorrhage indicates its exhibition. Eight or ten hours later, on removing the vaginal plug, the mass may be found expelled from the uterus and lying in the vagina. If ovum and decidua are whole, the further treatment is that of complete abortion; if not, it is that of the incomplete variety.

If nothing has been expelled, the cervix may be plugged with gauze, or a tupelo or laminaria tent (or small bundle of them) may be inserted, the vagina then being plugged again. This will arrest bleeding, dilate the cervix, and stimulate uterine contraction. It must be remembered, however, that the use of tents, and the delay while they act, gives an additional risk of sepsis. The mass may be naturally expelled after the tent has acted. Hot douching will greatly favour this termination.

Rapid dilatation of the cervix may best be performed with

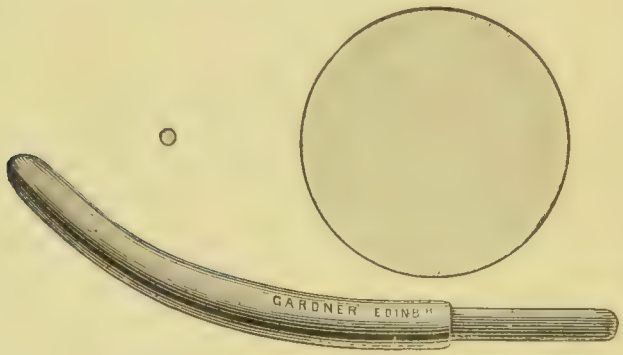


FIG. 17.—Hegar's Dilators. The two circles give the size of the smallest and the largest made.

the help of an anaesthetic, by introducing slowly, one after another, a series of Hegar's dilators. In the early months

this is sufficient, as any finger can be easily passed into the uterus after the larger numbers in Hegar's series. In a later abortion, say at the fifth month, it may be necessary to use also a hydrostatic dilator, or to continue dilatation with the fingers, as it is necessary to get most of the hand into the uterus to remove an abortion at this stage. It may be necessary to pull down the uterus during these manipulations, grasping, with a volsella, the anterior lip of the cervix.

Having obtained the necessary dilatation, the patient being anaesthetised if possible, a finger must be passed round and round the interior of the uterus, beginning at the os internum, and gradually separating the decidua, until the whole mass is free and lies loose in the uterine cavity. The external hand must press down the uterus from above during this process, grasping it firmly through the abdominal wall. The dorsal posture is the most convenient through-

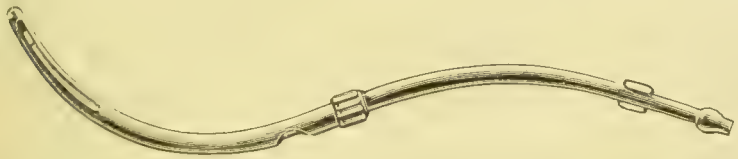


FIG. 18.—Fritsch Uterine Tube.

out these manipulations. When quite free, the mass can be hooked out with one or two fingers, though it may be caught and extracted with a pair of forceps if preferred. The treatment now becomes that of complete abortion.

Treatment of Complete Abortion.—When abortion is complete, the uterine cavity should be washed out with solution of mercuric perchloride or biniodide, phenol, permanganate of potassium, iodine, or some other antiseptic. The instrument used should provide for the free escape of the injected fluid from the uterine cavity. The tubes of Fritsch or Budin are good. Metal instruments are the best, as they can be boiled for sterilisation, and they are not liable, like glass ones, to break while

in use. Celluloid instruments cannot be boiled, and are gradually destroyed by the use of hot lotions. The stream may be provided by an ordinary rubber syringe; but better by a douche can, or by a syphon tube. The temperature of the douche should be 110 F. to 115 F., and may be raised to 120 F. if haemorrhage is to be checked. It may be well to plug the vagina and, possibly, also the uterine cavity if bleeding be severe. Ergot may also be given. The patient must be kept at rest as long as after an ordinary labour. Any packing that is used should be removed in 24 hours and a douche given. If no packing is used it is unnecessary to give any douches during recovery, unless the discharge is offensive or other symptoms of sepsis appear.

Treatment of Incomplete Abortion.—When abortion is not known to be complete, the cervix must be dilated, with the help of anaesthesia, until enough of the hand can be introduced to explore the whole of the uterine cavity, the external hand meanwhile grasping the fundus and pushing it down. The whole uterine wall must be scraped clean

FIG. 19.—"Martin's" Curette, first used by Roux.

with the fingers. In the early months a curette[1] may be used for this purpose; but one finger should always be introduced before leaving off, as remnants of decidua can be more accurately detected with the finger-end than by any instrument. Much trouble would be saved were this precaution always observed. The further treatment is that of complete abortion. If, however, portions of the ovum and decidua have been left some time in the uterus, and especially if they have become offensive and produced

[1] Dr Donald of Manchester uses a new flushing curette as well shaped as Martin's instrument, and having better arrangements for flushing than the older flushing curettes. It is made by Arnold.

malodorous discharge, antiseptic douching should be continued twice or three times daily until all discharge disappears. It may also be necessary to swab out the uterine cavity with a strong antiseptic such as pure phenol, liniment of iodine, or a mixture of the two. Drainage may be secured by lightly packing the cervix with antiseptic gauze.

Treatment of Missed Abortion.—If bleeding and dilatation of the cervix begin naturally, the case demands the same treatment as inevitable abortion. If missed abortion be diagnosed, and there are no symptoms of natural expulsion, the treatment may be commenced with a hot antiseptic douche and the introduction of a tent, or the patient may be anaesthetised and rapid dilatation proceeded with. When sufficient dilatation has been gained the mass should be separated and removed with the fingers, and the cavity thoroughly cleaned with the fingers, swabs, or a curette if necessary. The after-treatment of this condition must be careful, as there is a great tendency to subinvolution. This must be combated by frequent hot douches, applications of iodine to the endometrium, and prolonged rest in bed. Ergot and iron may be continuously administered during recovery to aid involution, and at a few subsequent menstrual periods, as menorrhagia is likely to occur. In making applications to the endometrium, a sound should

FIG. 20.
A. R. Simpson's Sound.

be covered by rolling a thin leaf of cotton-wool round it; this is then dipped into the solution to be applied, and

FIG. 21.—Volsella.

passed into the uterus, the os having been exposed with a Sims speculum, and, if necessary, a volsella.

CHAPTER X.

LABOUR.

CLINICAL PHENOMENA.

The Difficulty of Human Labour.

Other Mammalia. — Several causes render parturition more difficult in man than it is in other animals. The modifications of structure demanded for the maintenance of the erect posture are amongst the most important. The axis of the pelvic canal in the lower mammals is practically straight, and its antero-posterior diameter is longer than the transverse throughout. The pubic symphysis is relatively lower down, so that opposite the sacrum is the soft abdominal wall, while opposite the pubis is the movable caudal extremity of the vertebral column. Thus the head has passed the sacrum before it meets the resistance of the pubic bones. In the lower mammals the pelvic ligaments relax greatly during pregnancy, so that at labour there is great mobility at the sacro-iliac joints, and the pubic bones are in some animals widely separated. Further, the structures of the pelvic floor, not having to support the weight of the viscera, are relatively weak, and are canalised during labour with comparative ease. The foetal head, also, is relatively small, it is conical in shape, its attachment to the spine is terminal and at the blunt end of the cone.

Man.—In man, on the other hand, the axis of the pelvic canal is curved, and its antero-posterior diameter is less above, but longer below than the transverse. The pubic

symphysis is so placed that the head has to pass between it and the most prominent part of the sacrum, whose attachment to the iliac bones is specially firm and unyielding. The pubic symphysis also is rigid, the erect posture demanding a more closely knit pelvis than is found in quadrupeds. Similarly the structures of the pelvic floor are strong and elastic to support the weight of the viscera, so that they offer great resistance to the parturient powers and are consequently more injured by bruising and laceration during labour. The human uterus is enormously thickened and strengthened to enable it to overcome the resistances due to the form and nature of the bony canal and soft parts. The intimate union of the foetal and maternal elements in the placenta adds difficulty and danger to human labour in its later stage.

It is worthy of notice that domestication renders parturition difficult and dangerous to a certain extent in the lower mammals, animals kept in town and largely confined to stalls frequently needing assistance in labour. The lower human races are well known to be more independent and rapid in child-birth than the higher. This is not because the pelvis is smaller in the European races than in others; but because the head of the foetus in the lower races is smaller and more conical in shape than in the higher. Further, amongst Europeans the effect of culture and civilisation is apparent, as the upper and more luxurious classes have more difficult labours than the working classes, with a higher percentage of foetal and maternal mortality. It is also found that the birth of male children is attended with more danger to mother and child than that of females. The slightly larger size of the head explains this. It is stated that death of the mother occurs once in 79 births of male children, but only once in 159 births of female children, an average maternal mortality being about one in 120 cases.

Classification of Labours.

It is usual to divide labours into three classes :—those in which the head presents, those in which other parts of the body present, and those in which some element of danger is present apart from the question of presentation. These three classes are called **natural**, **praeternatural**, and **complicated** labours. The natural are subdivided into the normal and the morbid, the praeternatural according to the presentation, and the complicated or anomalous according to the nature of the complication.

The division of morbid head presentations into "Lingering" and "Instrumental" labours, is of course merely an artificial division made for convenience in classifying a number of labours after they are over, as, for instance, in the books of a maternity hospital. It is obvious that there is no natural division between lingering and instrumental labours, as any labour can be made an instrumental one at the will of the operator, and any can be allowed to conclude without operative interference. The distinction between "normal" and "morbid" labour, though more natural, is also more difficult to define. For the fact of operative interference at once defines an instrumental labour; but who shall define a normal one? Some authorities do so in one line; the definitions of others extend to a page, and state that no labour can be called normal until thirty days after it is over; that is to say, at the end of a puerperium free from complications! "It is a dull and obtuse mind," says Calvin, "that divides in order to distinguish"; but it is a still worse that distinguishes in order to divide. We shall therefore make no attempt to distinguish normal from morbid labour for the sake of neatness of classification. In recording cases it is convenient to put under the heading "normal" all vertex presentations which end favourably to mother and child, without operative interference, within 24 hours. Face cases, persistent occipito-posterior cases

and all slow labours ending naturally fall under the heading "Laborious," "Lingering" or "Delayed." Next come "Operative" or "Instrumental" cases. Then "Breech" and "Transverse" cases, and lastly, all attended by foetal or maternal "complications." Thus the linear classification for practical purposes, such as keeping a record, may be—

1. Normal; 2. Lingering; 3. Instrumental; 4. Breech; 5. Transverse; 6. Complicated.

For thinking about labours or describing them, it is more convenient to have a mental picture of them arranged as follows:—

- LABOUR
  - I. NATURAL
    - **Normal**
    - **Morbid**
      - Lingering.
      - Instrumental.
  - II. PRAETERNATURAL
    - **Breech.**
    - **Transverse.**
  - III. ANOMALOUS
    - **Maternal** Complications.
    - **Foetal** Complications.

THE CLINICAL PHENOMENA OF LABOUR.

In different schools, labour is divided into three, four, five, or even six stages—Prodromata, Dilatation, Propulsion, Expulsion, Delivery, and Puerperium. It is sufficient and usual in this country to speak of three stages only.

Stage I.—Canalisation or dilatation of the cervix and lower-uterine-segment.

Stage II.—Expulsion of the child.

Stage III.—Separation and Expulsion of the Placenta and Membranes.

FIRST STAGE.

PREPARATION AND DILATATION.

Premonitions.—The changes premonitory of labour may be spread over a month, or may occupy only a few days.

Before labour begins, however, the pudenda and vagina become moist, softened, and relaxed, together with all the structures of the pelvic floor. In primiparae the head of the child lies lower and more definitely in the pelvis at the end of pregnancy than in multiparae, in whom it often remains above the brim till labour begins. Generally, however, there is a subsidence of the uterus during the two or three weeks before labour, which may cause frequency of micturition and difficulty in walking; but which relieves the breathing and frees the abdominal organs from some of the pressure to which they have been subjected. In primiparae the cervix does not dilate before labour, in multiparae it may expand considerably; but the internal os remains palpable as well as the external os, and the cervical cavity is not taken up into that of the uterus.

Contractions of the Uterus.—The painless contractions of pregnancy become more frequent and regular, gaining in force till they finally become conscious to the patient, and painful. Their presence is recognised by the commencing dilatation of the cervix, though this process may advance considerably before actual pain is felt. True "pains" begin in the back, and pass round the sides towards the pubes. They begin gradually, increase in intensity, and die away gradually after lasting for some moments. The finger feels the os to dilate during a pain, and a hand placed on the abdomen recognises that the whole uterus hardens and erects itself, the fundus moving forwards and away from the spine. The breath is not held, so that the patient cries out freely during the pain, which is quite free from voluntary control. The foetal heart may be heard to beat more slowly during the pains, while the mother's pulse rate is quickened.

The Pain.—Some women suffer intensely during the first stage, while in others this stage, and indeed the whole process, may not cause much complaint. The cause of the pain has been variously explained. It has been

ascribed to pressure on nerves passing through the pelvis; but, if so, it would be referred to the extremities of these nerves in the lower limbs. This kind of pain occurs, but is different from the essential pain of uterine contractions, which has also been attributed to pressure on the nervous elements in the cervix; but it continues after the cervix is completely dilated, so cannot be due to this cause. Nor can the pain be caused by the pressure of the uterus upon its contents, for "after-pains" of the same nature occur after labour, when the uterus contains nothing but a little blood clot. The pain felt in the abdomen affects the whole uterine wall, resembles colic, and is akin to pain in the intestines, bladder or rectum when in a state of tetanic contraction, being due indeed to a sort of cramp of involuntary muscle.

A distinct pain felt during the first stage is due to the stretching of the cervix, which causes a dull aching in the sacral region. This is akin to the pain caused later by the stretching and tearing of the vagina and vulvar orifice, which is also distinct from the pain of uterine contraction during the second stage.

False Pains.—Other pains are often mistaken for those of labour, and cause much disappointment. They can only be recognised with certainty by noting that they are not causing dilatation of the cervix; but they usually differ from true pains in irregularity of occurrence, and in the fact that they are mostly abdominal, not commencing in the back and running round the sides like true pains. They frequently appear a month before labour is expected, and are due to cramp-like contractions of the abdominal muscles; partial and irregular contractions of the uterus, or to excessive peristalsis in the intestines. The usual causes are excessive fatigue, constipation, or a distended bladder, and the false pains should be treated accordingly.

Dilatation of the Cervix.—In examining the condition of the cervix it is usual to introduce a finger or two during

a pain, and to continue the observation till the contraction has passed off. The os internum first expands, and the membranes are separated for a short distance round it from that portion of the uterus known as the lower-uterine-segment. During a pain the membranes are stretched tightly across the os, bulging downward slightly at first, but more and more as the cervix becomes expanded. The os internum having disappeared, and the cervical canal having become continuous with the opened-out lower-uterine-segment, the os externum can be felt as a thin ring with a sharp, almost membranous edge during pains. The os may, however, be thick and hard owing to old inflammatory conditions. Its edge is smooth and regular in primiparae, but in multiparae it is often irregular owing to tears and their cicatrices produced at previous labours. The size of the os may be estimated as admitting one, two, or three fingers, the hand up to the knuckles, or the whole hand. Another way is to describe it as the size of a shilling, a florin, or a crown piece. The mucous discharge may be tinged with blood at the beginning of dilatation, owing to the separation of the membranes from the lower pole of the uterus. This is called a "show."

Formation of the Bag of Membranes.—The membranes separated from the lower-uterine-segment come to form a projecting bag filled with liquor amnii, some of which is in front of the foetal head. The bag should be regular in form, and rounded; but it may form a sausage or finger-like projection into the vagina. Tense during a pain, it fills the os and stretches it laterally, preventing palpation of the head for the time. Between the pains the bag slackens, and the head can be felt through it, a certain portion of it surrounded by the os, free from pressure and oedematous for this reason. Next comes a band—the girdle of contact, where the tissues firmly grip the head. Above this the foetus lies free in the liquor amnii. Dilatation proceeds much more quickly after the formation of the bag of mem-

branes. The internal os disappears at an early stage, but the external os remains palpable as a flaccid fold of mucosa lying flat against the sides of the fully dilated canal, which is about 4 inches in diameter. It is noted clinically that besides the longitudinal pull of the uterus on the cervix and the fluid pressure transmitted at right angles to its surface by the bag of membranes, there is a third cause of dilatation, namely, the exudation of fluid from the blood into the cervix, vagina and pudenda, softening and relaxing them before any direct pressure is applied to them, and providing fluid for the copious lubricating secretion they produce. This is exemplified in cases of double uterus, one side of which is parturient; for the os of the non-pregnant portion dilates along with the other, though there is no head or bag of waters to expand it. The vagina also dilates considerably in normal labour, while the head is still high up and unable to exert upon it any expanding pressure.

Rupture of the Membranes.—The membranes may give way, and allow the escape of a portion at least of the liquor amnii before dilatation is complete. On the other hand, they may remain intact until long after the pelvis is fully canalised, and in rare cases may never rupture at all, the ovum being expelled whole. Thus the end of the first stage does not coincide with the rupture of the membranes, but is reached whenever the cervix is completely dilated. The head is usually to some extent in the pelvis at the end of the first stage, the leading part being about at the level of the apex of the pubic arch. The so-called mechanism of labour begins at this point.

Second Stage.

Expulsion of Child.

Change in Pains.—When the dilatation of the canals is really complete there is a marked change in the character

FIG. 22.

Human ovum expelled complete, with membranes unruptured. Length of foetus in ovo, 9 inches. Age, $7\frac{1}{2}$ to 8 months. Drawn from nature from a fresh specimen lent by Dr Prince Stallard, Manchester.

of the pains. When the uterus contracts the breath is held, the glottis being closed and the diaphragm being fixed, the abdominal walls and all the accessory expiratory muscles aid expulsion by increasing the intra-abdominal pressure. This action of voluntary muscles in aiding the uterus is not voluntary in origin, as it goes on when the patient is unconscious or under the influence of anaesthetics. The patient, however, can greatly add to the efficacy of these so-called "down-bearing" pains by voluntary effort. Accordingly she will press her feet against one firm object, and grasp another with her hands, so fixing the pelvis and the thorax, and will then strain, as in defaecation, to expel the contents of the parturient canal. The glottis being closed, the woman does not cry out while bearing down, but at the end of the effort she may exclaim loudly. These pains are longer in duration than those of the first stage, and may be no less frequent.

Descent of the Head.—Examination just after the rupture of the membranes is useful, because later the pressure of the girdle of resistance—now the walls of the vagina—causes increasing oedema of the scalp where it is least pressed upon—*i.e.*, in the part exposed to the examining finger—and this obscures the sutures and renders their palpation more difficult. The back of the child's head is found to occupy one side of the pelvis to the front, and it descends during each pain, rising again somewhat in the intervals. As the head gradually descends, the back of it moves round from the side to the front of the pelvis. The soft parts in front are drawn up out of the way, those behind being pushed down by the advancing head till the perineum is seen to bulge, and the anus to be dilated, so that the anterior wall of the rectum is visible through it. Hart[1] has measured the anus at its moment of maximum dilatation, and finds it D-shaped, the flat side of the letter towards the vagina—antero-posterior diameter, 1 inch ($2\frac{1}{2}$

[1] Selected Papers, p. 141.

cm.); transverse diameter, slightly more. He also finds that the urethra is dilated during labour, as it measures 6-8 mm. at the end of pregnancy, but 9-12 mm. after labour. The perineum is greatly lengthened and flattened out, so that, measuring 1½ inches from anus to vagina before labour, it measures 3 and 4 inches late in the second stage, and even more just before the escape of the head. The labia majora and minora are flattened out, giving skin to cover the bulging parts.

Height of Fundus.—Measuring from the pubes, the fundus is found to be quite as high just before the escape of the head as at any previous time. This fact was first pointed out by Schroeder and Stratz. The author[1] found the average height of the fundus above the pubes 9.5 in. during the first stage, and 9.8 in. at the end of the second stage—the fundus usually rising ⅓ in. during labour, though it may rise as much as two inches. The uterus is thus elongated, and it is correspondingly narrowed from about 8 in. to about 7 in. in breadth during labour, its antero-posterior diameter being shortened to a similar extent. The breech of the foetus being at the fundus, and its head at the vulva at the end of the second stage, it is clear that the foetus is narrowed and elongated as a mass previous to its expulsion. The cavity of the uterus is thus much lessened during the second stage, for a large part of the liquor amnii has escaped and a large part of the foetus is no longer in the uterus but in the dilated cervix and vagina.

Contraction and Retraction. — This lessening of the uterine cavity is caused by the retraction of the uterine muscle. After each contraction there is relaxation, but this is not complete, and each muscle fibre, after the temporary shortening and thickening of contraction is over, retains a certain degree of shortening and thickening called retraction. Thus contraction is temporary and transient, while retraction is permanent and progressive. As labour goes on, a ring

[1] Edin. Med. Journal, June 1895.

may be felt to form round the uterine cavity, above which the uterine wall is thick, while below it is thin. The thickening of the wall at this ring can be felt from the inside of the uterus, and if labour be prolonged, can be palpated through the abdominal wall. Its significance is that only a part of the uterine wall contracts and retracts—namely, that above the ring, while the uterine wall below this is passive, and is stretched and thinned during labour. Though anatomically a part of the body of the uterus, we thus have clinical evidence that this lower segment of the uterus is physiologically like the cervix and vagina, in as much as it is passive during labour, being canalised, thinned, and stretched by the passage of the foetus. The lower limit of the contracting and retracting part of the uterus is known as Bandl's ring, or the **retraction ring**. It has erroneously been called the contraction ring, for it is permanent and progressive and due to retraction—not temporary and due to contraction. (Barbour.)

Escape of the Head.—The back of the child's head finally appears under the pubic arch, and is born first, traversing the short anterior wall of the canal, while the face sweeps over the longer posterior wall. There is no arrest of the occiput at the pubic arch, and no rotation about a fixed point. The back of the head does not cease to advance, but merely travels more slowly than the face. The most painful point in labour is when the head finally escapes at the vulvar aperture. In primiparae the hymen is always torn, usually there is also some laceration of the fourchette, and frequently the mucous membrane of the vagina and the skin of the perineum are also torn. Laceration of the perineum in multiparae is of much rarer occurrence. The fundus now sinks, the uterine wall following the foetus closely so that no empty space ever exists within the uterus. A short period of rest usually follows the birth of the head. The child's face becomes cyanosed during contraction of the uterus through temporary arrest of the

placental circulation. Permanent cyanosis shows that the circulation is stopped by pressure on the cord and does not imply that the placenta has been separated. The child's face escaped looking towards the mother's back, but it

FIG. 23.—Escape of the Head. Drawn from photo. by Dr A. K. Melville. Shows caput; flexion maintained, occiput leading; D-shaped anus.

now moves round to one side as the shoulders pass through the pelvic canal. They are expelled, one anterior the other posterior relative to the mother, and the rest of the body follows easily. The child now cries more or less vigorously and begins to breathe, but the placental circulation continues for four or five minutes and sometimes for a quarter of an hour, as is shown by pulsation in the cord. Unless there is laceration of the cervix, vagina or perineum there is normally no bleeding until after the birth of the child, showing that the placenta is not separated till the third stage has begun.

Third Stage.

Separation and Expulsion of the Placenta.

After a brief interval uterine contraction and retraction begin again, and the escape of a small quantity of blood shows that the placenta is being separated. The uterus now contains nothing but the placenta and membranes; there may also be a little blood clot, but no empty space —*i.e.*, no space filled with air—as the walls are in contact with the placenta on all sides. The fundus is about the level of the umbilicus, and the uterus is felt to be flattened antero-posteriorly. A hand passed into the uterus finds the placenta folded longitudinally by the lateral compression of the uterine walls. If separation has commenced it is usually at the lower edge, which soon protrudes below the retraction ring into the flaccid lower-uterine-segment and cervix. As contraction and relaxation proceed with retraction of the active portion of the wall, the placenta is separated and expelled into the passive lower part of the canal. This raises the fundus again an inch or two. The presence of the placenta in the vagina usually calls forth voluntary expulsive efforts as in the second stage of labour, and the mass may be expelled, dragging after it the membranes. Otherwise the placenta lies in the vagina till it is removed artificially or by the aid of gravitation. There is normally no great loss of blood during this process, twelve ounces being a very full estimate. The placenta normally is expelled with its lower edge leading, as described by Duncan. Champneys found in seventy cases that sixty presented the lower edge, or a point on the foetal surface within two inches of it. Schultze taught that normally the placenta escapes inverted, the foetal surface presenting near the insertion of the cord, and this doubtless occurs occasionally when the site of the placenta is at the fundus, but it certainly is not the general rule.

The fundus sinks below the umbilicus on removal of the placenta, and the uterus contracts firmly to the size of a cricket ball. A few hours later, it is again found softer and larger, the fundus at the umbilicus, where it remains for two or three days, before involution really begins.

The pulse, which is rather rapid during labour, is slow after the third stage, 60 per minute being an average rate. Most labours are nocturnal, the majority beginning between 9 and 12 P.M., and ending between 12 and 3 A.M. The average duration of labour may be stated at twenty hours for primiparae, and twelve hours for multiparae. The first stage is three or four times as long as the second, and the third occupies normally 20-30 minutes.

CHAPTER XI.

LABOUR—*Continued.*

THE FACTORS.

(These are the **Powers**, the **Passages**, and the **Passengers.**)

Factor I.—The Powers.

1. The Uterus; 2. The Accessory Powers; 3. Weight of the Passengers.

1. **The Uterus.**—Various attempts have been made to estimate the force of the uterine contractions. By the use of hydraulic instruments and of shot contained in cylinders it has been found that an average weight of about 15 lbs. is necessary to rupture the membranes, the extremes being $4\frac{1}{2}$ lbs. and 36 lbs. A manometer, being attached to a rubber bag inserted in the uterus, registered the force of different contractions as equal to a weight of from 17 to 55 lbs. The contractions continue when the patient is under the influence of anaesthetics, and during coma. They are said to have been observed three-quarters of an hour after death. The mental state has a marked effect on uterine action, even during the first stage of labour, when pains are involuntary; during the second stage voluntary effort only increases the efficacy of the accessory powers. Uterine contraction is initiated by periodic discharges of nerve energy, as during pregnancy; and also by reflex stimulation, as by sucking or other irritation of the nipples. The pressure of the ovum stimulates the nerves of the uterus itself, which belong to the sympathetic system, as do those in the vagina,

stimulated by the presence there of a plug, the examining hand, the head of the child, or the placenta. Thus notices to contract reach the uterus from the central nervous system —(1) having originated in it, (2) having reached it by the spinal nerves, or (3) having reached it by sympathetic nerves.

Experiments indicate that there are two centres controlling the uterus. One is in the medulla, and by it messages from the higher nerve centres and reflex stimuli received through cerebro-spinal nerves are transmitted to the uterus. The other is in the lumbar cord, and has more definite control over the uterus, transmitting to it stimuli from the centre in the medulla and reflex stimuli from the fibres of the sympathetic situated in the uterus itself and in other pelvic organs. There are also in the uterus nerve elements which render it capable of rhythmic contraction, even when separated from all other nervous control. The movements of the uterine muscle are said to be peristaltic, the wave commencing at the fundus; but the contraction of the whole organ is almost simultaneous. Helme found that each "pain" consists of three parts—(1) contraction; (2) maintenance of contraction; (3) relaxation. The relaxation he ascribes to the muscle fibres themselves, either by elastic recoil to their previous shape, or by contraction in their short axis. The relaxation is not complete, so that after each contraction is over, a certain amount of retraction remains—permanent and progressive as labour proceeds. The cavity of the uterus thus gets less and less after each pain. It is necessary to consider the uterus as two parts —one active, the other passive. The passive part is the so-called lower-uterine-segment, or the lower pole of the uterus for two or three inches above the os internum; the active part is the rest of the corpus uteri; and the functional boundary between them is the ring of Bandl, or retraction ring. The uterus acts alone during the first stage in dilating the cervix and lower-uterine-segment; with the accessory powers during the second stage in expelling the

child; during the third stage it acts alone while separating the placenta, and expelling it from the retracting portion, but with the accessory powers in expelling it from the lower-segment, cervix and vagina.

It is noteworthy that when the upper part of the uterus is in a state of contraction, the cervix is often relaxed, and *vice versâ*. Thus during pregnancy, if anything sets up uterine contraction, the cervix dilates; and if anything dilates the cervix, uterine contraction is initiated. When, in labour, there is spasmodic closure of the os, it is usually accompanied by cessation of the contractions of the uterine body. This leads us to look upon the muscles round the cervix as a sphincter, contracted as a rule, but relaxed at certain times, to allow of the expulsion of the contents of the cavity it guards. Thus we may state alike of bladder, uterus and rectum, that when these organs are to be emptied the sphincter is relaxed, the muscular wall of the organ contracts, and intra-abdominal pressure is raised by voluntary action to aid in expelling the contents.

2. **The accessory powers.**—These are identical with those used in defaecation and urination. They include all muscles which can aid in raising intra-abdominal pressure. The muscles of the abdominal wall compress the cavity; the glottis being closed, the intrinsic and extrinsic muscles of expiration fix and depress the diaphragm; the muscles of the limbs fix the thorax and pelvis, so giving fixed points for the other muscles to work upon. The action of the accessory powers tilts forward the uterus, approximating its long axis to that of the pelvic brim; it adds to the expelling force, and presses the whole uterus downward, so preventing excessive stretching of the passive part of the organ. The accessory powers act during the second stage and during the later or expulsive part of he third stage.

3. **Weight of the Uterine contents.**—This acts only when the patient is in certain positions, and is unimportant as regards the child. Gravity is sufficient to remove the

separated secundines if the patient sit up or stand at the end of the third stage.

Resistance to the powers is offered by the lower-uterine-segment and cervix, the membranes, the vagina and pelvic floor, including the vulvar outlet, and by the curved canal of the bony pelvis. The attachment of the placenta adds a resistance in the third stage.

General fluid pressure.—The plastic body of the foetus forms, together with the liquor amnii, one mass, which acts mechanically like a fluid. That is to say, it transmits force applied to it in all directions at right angles to its surface. At the beginning of labour, therefore, when the cervical canal is undilated, we have the mass compressed by the uterine wall, except over the lower uterine segment, which is passive. The mass of the ovum transmits the pressure of the active portion as a dilating force to the passive portion, with the addition of a small force due to gravity. At the same time, the longitudinal pull of the active portion, so to speak, stretches the passive portion over the tense lower pole of the ovum. This separates the membranes from the stretched lower-uterine-segment, and begins to open up the cervical canal. But now the tense membranes can bulge into the opened os internum, and as they transmit force at right angles to their surface, a portion or component of the total force acting, is now directed laterally against the wall of the cervix, so acting at a greater advantage in producing dilatation. And the more the bag of membranes bulges and protrudes into and through the cervical canal the larger is the lateral or directly dilating component of the total force. Thus the general contents pressure acts first in dilating the lower-uterine-segment and cervix.

It is noteworthy that the contraction and retraction of the uterus is mainly lateral rather than longitudinal, as the organ is not shortened but rather lengthened up to the end of the second stage. The reduction in size of its cavity is thus due to narrowing alone, and corresponds with the

narrowing and elongation of the foetal mass. The addition of the accessory powers only increases the general fluid pressure transmitted by the mass to the lower pole of the uterus, and does not alter its nature in any way.

Factor II.—The Passages.

1. **Soft Parts.** 2. **Bony Pelvis.**

1. The Soft Parts.

These are the lower-uterine-segment, the cervix and the vagina, and may together be considered as consisting of two parts—an anterior and a posterior—the pelvic organs and tissues in front of the canal and those behind it. After the pelvis has been canalised, the anterior portion is practically out of count, as the bladder and connective tissue are pulled up into the abdomen, leaving the smooth, short, bony front wall of the pelvis lined by the thinned cervix and vaginal wall. The posterior portion of the soft part is, however, of the utmost importance, being a large mass of muscular and connective tissue, which, in virtue of its resiliancy, offers great resistance to the advancing foetal mass, and causes striking modifications of the mechanism of labour. Thus Hart[1] has shown that the pelvic floor consists of two roughly triangular portions divided by the vaginal cleft. The anterior or pubic segment contains the anterior vaginal wall, the urethra, bladder and retropubic connective tissue, and the peritoneum over the bladder. The triangle has its base loosely connected to the pubes; above it is the peritoneum, below it is the anterior vaginal wall, its apex being just in front of the cervix. The posterior or sacral segment contains the posterior vaginal wall, the perineal body, the rectum and anus, parts of the gluteus maximus and obturator muscles, with coccygeus, levator ani, transversus perinei

[1] "Atlas of female pelvic anatomy," and "Structural anatomy of female pelvic floor."

—in fact, all the muscular and connective tissue attached to the sacrum and coccyx. This triangle has its base firmly attached to the sacrum and coccyx; above it is the posterior vaginal wall and, posteriorly, peritoneum; below it is the skin of the perineum and skin behind the anus. The apex of the triangle is at the anterior angle of the perineal body. In parturition the pubic segment is drawn up by the uterus, while the sacral segment is pressed down by the advancing foetal mass. Thus the bladder and connective being pulled up above the brim, the anterior wall of the vagina forms a continuous curve with the cervix and lower-uterine-segment in front. The posterior vaginal wall, still bounding the now depressed sacral segment, is continuous with the cervix and lower-uterine-segment behind, which now line the hollow of the sacrum. Hart compares the opening of the pelvic floor to the passage of a person through folding doors, one of which he pulls towards him (anterior segment), while he pushes the other before him (posterior segment). (See Fig. 1, p. 2.) The soft parts lining the bony pelvis modify the form and size of its cavity in some degree. The iliacus and psoas muscles fill up the false pelvis, and overhang the brim, shortening its transverse diameter. The conjugate and the right oblique are not much interfered with; but the left oblique is shortened by the passage of the lower bowel across the left sacro-iliac synchondrosis. Below the outlet of the bony pelvis the soft parts form a curved canal about 4 inches in diameter during the passage of the foetal head. The anterior wall is short, extending about 1½ inches below the pubes, while the posterior wall measures 5 to 7 inches in length when fully canalised. (See Fig. 35.)

2. Hard Parts. The Bony Pelvis.

The pelvic girdle may be considered in relation to its various functions, namely, as transmitting the weight of the

body to the legs in walking and standing, and to the ischia in sitting, or as protecting the pelvic viscera. The form of the human pelvis may be shown to have been evolved in accordance with the demands of the erect posture. But we need only consider the structure as a canal through which the foetus has to pass, and therefore omit all details of the structure and development of the ossa innominata, sacrum and coccyx, which are found in anatomical works.

The pelvis, from the obstetric point of view, consists of two parts, the **true pelvis** and the **false**, divided by a line known as the brim, which bounds the inlet of the true pelvis.

The **false pelvis** presents certain features which indicate the shape of the true, and its measurements are therefore important. The straight line between the anterior superior iliac spines is 9 to 10 inches in length, that between the most distant points on the iliac crests, 10 to 11 inches. In a well-formed pelvis the **intercristal** diameter should be 1 inch longer than the **interspinous**. The great trochanters should be 11 to 12 inches apart.

The brim.—Beginning at the upper margin of the pubic symphysis the brim runs along the upper margin of the pubic bone, along the ilio-pectineal line to the sacro-iliac synchondrosis, thence along the upper and anterior margin of the wing of the sacrum to the promontory, and so round the other side to the pubic symphysis again. The surface bounded by the line thus described is not a flat one, so that the term "plane of the brim" is, strictly speaking, a misnomer. This surface is the upper limit of the cavity of the true pelvis.

The conjugate or antero-posterior diameter of the brim measures 4 inches from the promontory to the upper margin of the pubic symphysis.

The transverse diameter of the brim is the greatest lateral measurement and is 5 inches.

The oblique diameters are measured from one sacro-iliac

synchondrosis to a point on the other side of the brim, opposite the ilio-pectineal eminence. Writers in this country and Germany name the oblique diameters from behind, thus the right oblique is that measured from the right sacro-iliac joint. In France the terms are used in the opposite sense, the right oblique being measured from the right ilio-pectineal eminence. The oblique diameters measure about $4\frac{1}{2}$ inches, the right being a trifle the longer of the two.

The Cavity.—The true pelvic cavity has a short wall in front, longer ones laterally, and a long curved wall behind;

FIG. 24.—Female pelvis.

for in front are the pubic bones, at the sides are the ischia, and behind is the sacrum. The obturator foramina, being filled in with soft structures, give certain extra available space in front. The strong sacro-sciatic ligaments form part of the posterior wall of the cavity and practically convert the sacro-sciatic notches into foramina filled up with soft structures. The coccyx being movable, it is advisable to consider it as forming a portion of the posterior segment of the soft parts, as for practical purposes the cavity of the bony pelvis ends at the tip of the sacrum. A plane crossing the cavity, midway between outlet and inlet,

measures about $4\frac{1}{2}$ in. in any diameter. The anterior wall of the cavity is $1\frac{1}{2}$ in. in length. The tip of the sacrum is about $3\frac{3}{4}$ in., that of the coccyx $4\frac{1}{4}$ in., below the conjugate of the brim. The lateral wall is about $3\frac{1}{2}$ in. in length, the tuberosities of the ischia being that distance below the brim. The cavity narrows laterally and widens antero-posteriorly from above downwards.

The outlet.—The outlet of the pelvic cavity has the tip of the sacrum behind, the apex of the pubic arch in front, and the ischial tuberosities at its sides. The anterior half of the outlet is thus bounded by the pubic arch, the posterior half by the sacro-sciatic ligaments. The four

FIG. 25.—Male pelvis.

points marking the angles of this diamond-shaped space are by no means in the same plane, the ischial tuberosities being fully an inch below a line joining the apex of the pubic arch with the tip of the sacrum. Theoretically, the tip of the coccyx may be considered to mark the posterior angle of the outlet, but we take the tip of the sacrum for practical obstetric purposes. The transverse of the outlet is 4 in. in length, the antero-posterior diameter 5 in., and its oblique diameters $4\frac{1}{2}$ in.

The important measurements of the true pelvis may be tabulated and easily remembered as follows :—

	Transverse.	Oblique.	Antero-posterior.
Inlet, .	5	$4\frac{1}{2}$	4
Cavity, .	$4\frac{1}{2}$	$4\frac{1}{2}$	$4\frac{1}{2}$
Outlet, .	4	$4\frac{1}{2}$	5

Male and Female pelvis.—As compared with the female pelvis, that of the **male** has thick, heavy and rough bones. It is narrower, especially in the transverse, and the walls converge more towards the outlet, the cavity being deep and funnel-shaped. The pubic arch is markedly narrower, having an angle of about 75°. The obturator foramina are more triangular in shape. The promontory projects more, and the coccyx is less movable. Accordingly, the **female pelvis** is distinguished by—

1. The lightness and smoothness of its bones.
2. The large size of the brim, especially in the transverse.
3. The relative shallowness of the cavity and its greater size below.
4. The large size of the outlet, and mobility of the coccyx.
5. The width of the pubic arch, which has an angle of about 95°.
6. The rounded form of the obturator foramen.
7. The eversion of the rami of the pubes and ischia.
8. The relative breadth of the false as well as of the true pelvis, as noted in interspinous and intercristal diameters, the transverse at the brim, and the transverse at the outlet.

Inclination of the Pelvis.—The brim makes with the horizon an angle of about 54 degrees. Different estimates of this angle may vary greatly. Separating and everting the legs, the pelvis is tilted forwards and the angle is increased

very greatly. The dried pelvis may be held approximately in that position which it occupies in the erect female, by keeping the upper margin of the symphysis and the anterior superior iliac spines in one perpendicular plane, as, for instance, by holding them against a wall. The acetabular notch then points directly downwards, and the tip of the coccyx is slightly above the apex of the pelvic arch, as the conjugate of the brim makes an angle of about 50° with the antero-posterior diameter of the outlet.

Axis of the Pelvis.—It is not unusual to define the axis

FIG 26.—Diagram of a simple construction for the pelvic axis.

of the pelvis as an imaginary line described by the centre of the foetal head during parturition, and then to describe more or less elaborate processes by which such a curve may be represented upon a diagram. In order to do this to much purpose it would be necessary to define the centre of the foetal head, to prove that it moves in a certain curve, and to prove that the line on the diagram represents that curve. It would then be necessary to consider what is the axis of the pelvis in breech and other presentations!

Further, the head varies, the pelvis varies, and the way in which the head passes through the pelvis varies. It seems more in accordance with the dictates of common sense to define the axis of the pelvis in terms of the pelvis than in terms of an object which may pass through it. The axis, then, of any pelvis is a line passing through the pelvic cavity midway between its walls. As the cavity is curved, so is its axis a curved line. To represent diagrammatically the axis of any pelvis, draw a mesial section of the pelvis from measurements, draw the conjugate of the brim, and, as the cavity is practically a cylinder down to the apex of the pubic arch, draw a parallel to the conjugate through the lower margin of the pubic symphysis. Now draw the antero-posterior diameter of the outlet, and any number of lines from the lower margin of the symphysis to different points on the sacrum. Bisect the conjugate and all the other antero-posterior diameters drawn, and the line joining the points of bisection will be a curve representing the axis of the pelvis. Having thus defined the axis in terms of the pelvis, and given a construction representing it sufficiently well for practical purposes, it may be remarked that, if the head pass through the canal, fitting it closely, the centre of the head will pass down the centre of the canal, just as the sides of the head will pass down the sides of the canal; but this is all we know of the relation of the centre of the head to the axis of the pelvis.

Articulations of the Pelvis.—The auricular surfaces of the sacrum and of the iliac bones are covered with articular cartilages which meet in the **sacro-iliac synchondroses**, but are partially separated by a small synovial cavity in each joint. During pregnancy the synovial cavities are increased in size, the cartilages are swelled, and the ligaments uniting the bones are relaxed. Thus the small amount of movement usually possible at the joints is increased during pregnancy, and at parturition a very sensible degree of movement is present. Thus the pelvis can be tilted up-

ward or downward about an axis passing through the two sacro-iliac synchondroses. As this axis passes through the sacrum at some distance below the promontory, the tilting downwards of the pelvis removes the symphysis from the promontory and approximates it to the tip of the sacrum, thus increasing the conjugate and diminishing the antero-posterior diameter of the outlet. Similarly, tilting upward of the pelvis shortens the conjugate and increases the outlet. As the axis of rotation of the pelvis is nearer the promontory than the tip of the sacrum, the antero-posterior diameter of the outlet is more altered by these movements than that of the inlet. (See Fig. 59.) Matthews Duncan estimated the increase of the conjugate on tilting the pubes downward at $\frac{1}{3}$ of an inch.

The **pubic symphysis** is a mass of cartilage thicker in front than behind, and containing a small synovial cavity. The **sacro-coccygeal** articulation contains a small synovial cavity and permits of free movement in the normal adult female. The ligaments of the pelvis all become relaxed, the cartilages swell, and the synovial cavities are enlarged during pregnancy, so allowing slight mobility at otherwise rigid joints.

Pelvimetry.—To measure the pelvis during life, a pelvimeter or large pair of callipers is necessary. The **interspinous** (9-10 in.), **intercristal** (10-11 in.), and **intertrochanteric** (11-12 in.) diameters are directly measured. To form an idea of the length of the conjugate, indirect measurements may be taken. The **external conjugate** is measured from the upper margin of the pubic symphysis to the depression below the spine of the last lumbar vertebra. This is found just above a line joining the superior posterior iliac spines, whose position is indicated by dimples or may be discovered by palpation. The external conjugate should measure not less than $7\frac{1}{2}$ inches; for allowing $3\frac{1}{2}$ inches for the bones and soft parts, this gives a true conjugate of 4 inches. The **diagonal conjugate** is

measured from the promontory of the sacrum to the apex of the pubic arch, and should be $4\frac{1}{2}$ inches in length. To obtain this diameter two fingers must be placed in the vaginal

FIG. 27.—Measuring the diagonal Conjugate.

so that the tip of the middle finger touches the promontory and the forefinger presses against the lower margin of the pubic symphysis. With the nail of a finger of the other hand the position of the symphysis is marked on the forefinger, and the hands having been withdrawn in position a measurement is taken. Subtracting half an inch from this, an indirect estimate of the true conjugate is obtained. In flat pelvis the extra slope of the pubic symphysis makes it necessary to subtract $\frac{2}{3}$ or $\frac{3}{4}$ in. instead of $\frac{1}{2}$ in. Several instruments have been devised for measuring the diagonal conjugate, but none is better than the fingers of a careful observer.

During the third stage, or after labour, the **true conjugate** can be measured directly by fitting the fist or the fingers into it, and the diameters of the outlet may be similarly estimated.

There is yet another way in which the true conjugate may be estimated in a thin woman. For by laying a hand upon the hypogastrium and pressing the finger ends

gradually towards the spine, the finger tips can be rested against the promontory while their bases rest on the pubic symphysis. The abdominal wall is in front of the promon-

FIG. 28.—Estimating the true Conjugate externally in a thin subject.

tory and also in front of the pubes, so that a measurement on the fingers gives a good idea of the true conjugate.

FACTOR III.—THE PASSENGERS.

1. **The Foetus.** 2. **The Placenta and Membranes.**

1. THE FOETUS.

Throughout labour the foetus may be considered as consisting of three parts. 1. The free part which can be touched by the examining finger and is surrounded by the cervix and vaginal walls and vulvar aperture successively as labour goes on.

2. The part gripped by the girdle of resistance, that is to say, the band or ring round the foetus where it is closely in contact with the part of the canals being dilated at the time. The girdle of resistance is formed first by the cervix, then by the vaginal walls, and

lastly by the vulvar orifice. The plane of resistance is a plane bounded by the girdle of resistance.

3. The part of the foetus above the girdle of resistance, and acted upon by the general-contents-pressure of the uterus and accessory powers.

It has already been mentioned that the foetus as a whole, with the liquor amnii, forms a mass which acts like a fluid in receiving and transmitting in all directions force applied to it. The mass is elongated and narrowed during labour, so that before expulsion it occupies the whole cavity of the retracted uterus, and the dilated lower-uterine-segment, cervix and vagina.

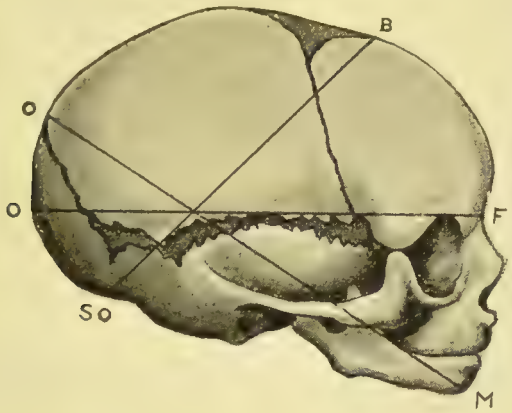
Foetal head.—The bones of the foetal head are incompletely ossified, so that the cranium is completed by membranous structures, forming wide sutures between the margins of the bones and spaces between their angles. The right and left frontals are separate, and, like the parietals and the occipital bone, are freely movable. The landmarks of the foetal head are the bony eminences, the sutures and the fontanelles.

Eminences.—The most prominent portions of the frontal and parietal bones are called respectively the frontal and the parietal eminences. The root of the nose is a point easily recognised, and is called the glabella. The protuberance of the occipital bone may also be recognised. The chin and the ears may be palpable, and form useful landmarks.

Sutures.—The suture in the middle line is called the frontal suture, where it lies between the frontal bones, and the sagittal suture, where it separates the parietals.[1] The coronal suture separates the parietals from the frontals, and the lambdoidal suture separates the parietals from the occipital.

[1] The whole suture running from the tip of the occiput to the root of the nose, between the parietals and between the frontals, is often called the sagittal suture.

Fontanelles.—Where the sagittal and frontal sutures meet the coronal sutures a lozenge-shaped space is formed between the angles of the frontal and parietal bones—which is the anterior fontanelle or the **Bregma.** Where the sagittal suture meets the lambdoidal sutures there is hardly



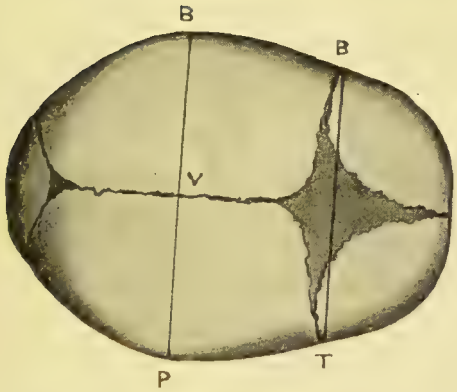


FIG. 29.—The Foetal Skull.

o.m. = occipito-mental diameter.
s.o.b. = sub-occipito-bregmatic diameter.
o.f. = occipito-frontal diameter.
b-t. = bi-temporal diameter.
b-p. = bi-parietal diameter.
v. = vertex.

a space, but rather a triradiate sulcus between the parietals and the tip of the occiput, which is known as the posterior fontanelle.

Regions.—A line drawn between the two parietal eminences cuts the sagittal suture at a point known as the

vertex. The part of the head in front of this is called the sinciput, that behind the vertex is the occiput. Some authorities, instead of describing the vertex as a point, define it as a region of the head lying between the bregma and the posterior fontanelle, and bounded laterally by the parietal eminences. The regions of the head would thus be occiput, vertex, brow or sinciput, and face.

Diameters.—These are measured from varying points; but those given below are the most generally understood and useful :—

1. Occipito-mental—from the tip of the chin to the tip of the occipital bone, . . . 5 in.
2. Occipito-frontal—from the glabella to the occipital protuberance, ... $4\frac{1}{2}$ „
3. Sub-occipito-bregmatic—from the anterior angle of the bregma to the junction of the back of the head with the neck, ... 4 „

In the dried skull 3 is measured to a point midway between the occipital protuberance and the foramen magnum. A diameter longer than the occipito-mental is got by measuring from the chin to a point on the sagittal suture near the tip of the occiput. A diameter shorter than the sub-occipito-bregmatic is got by measuring from the junction of head and neck to the middle or to the posterior angle of the bregma. These are the antero-posterior diameters. The transverse diameters are :—

1. Bi-parietal—joining the parietal eminences, . $3\frac{1}{2}$ in.
2. Bi-temporal—joining the widest points on the coronal suture, ... 3 „
3. Bi-mastoid; and 4. Bi-zygomatic diameters, about . . . . . $2\frac{3}{4}$ „

Vertical diameters are :—(1) Fronto-mental, 3 in.; and (2) Trachelo-bregmatic, 3 in. The last four diameters mentioned are of little importance.

Circumferences.—Callipers are necessary for measuring the diameters, and these are not always forthcoming; but the following circumferences can be taken with a tape, and are very useful measurements:—

Occipito-mental circumference, . .	16 in.
Occipito-frontal „ . .	14 „
Sub-occipito-bregmatic „ .	11-12 „

The tape must be held so as to pass through the points between which the similarly named diameters are measured.

The heads of male children average ½ in. more in circumference than those of females, so that more males are still-born or die soon after birth. In the lower races the head is smaller and less round, the flatness of the forehead giving a short sub-occipito-bregmatic. Amongst Europeans distinctions can be observed, as, for instance, between the long head of Celtic races and the rounder head of Teutons.

It has been noted that the foetal head is wedge-shaped in certain directions, and this is said to influence the mechanism of labour. Thus, viewed from above, the side of the head slopes gently away from the parietal eminences forwards; but behind them it slopes sharply back to the occiput. Viewed sideways the head slopes gently forward and sharply backward from the vertex, and viewed from the front the head is broad above and narrow below.

Pressed upon during labour the edges of the bones slip under each other, allowing of head moulding. The tip of the occiput dips under the parietals, the parietals also override the frontals. Antero-posterior shortening of the head caused by this telescoping of the bones is compensated for by lengthening of the vertical diameters, and not by increase in the transverse diameters.

Lateral pressure causes dipping of the bones which lie next the posterior segment of the pelvic floor. The distortions peculiar to different mechanisms will be mentioned

in their proper places, as will be the production of oedematous swellings of the scalp (caput succedaneum) over portions of the head free from pressure, and surrounded by the girdle of resistance.

2. The Placenta and Membranes.

During the third stage of labour the passenger consists of the placenta and membranes, or secundines as they are often termed. They call for no fresh anatomical description here, and as our views of the third stage have been much modified by recent study of frozen sections, the whole subject will be fully considered in Chapter XIII.

Summary of Stages and Factors.

First Stage.—Powers—The uterus.
Passages—Lower uterine segment and cervix.
Passenger—Forewaters in bag of membranes and presenting part.

Second Stage.—Powers—The uterus and the accessory powers.
Passages—The parturient canal of bony and soft parts.
Passenger—The child.

Third Stage.—Powers—Uterus and accessory powers.
Passages—Lower uterine segment, cervix, and vagina.
Passenger—Placenta and membranes.

CHAPTER XII.

LABOUR—*Continued.*

RELATION OF THE FACTORS.

Presentation.—We have already seen (Chapter VI.) that the head usually presents (96 per cent. of all cases), and we must now consider more definitely what part of the head presents in normal labour, remembering that cases of face and brow presentation are not quite of this nature. For the present purpose, the presentation at any time is that part of the foetal head which is, at that time, in the axis of the parturient canal. Thus the presenting part will at first be that which is in the centre of the dilating os, later in the centre of the vaginal canal, and finally in the centre of the vulvar aperture. In other words, the presenting part, at any time, is the centre of the portion of the foetal head surrounded by the girdle of resistance, and palpable by the examining finger.

It is first possible to accurately determine the presentation when the cervix is partly dilated, that is after labour has begun. In most cases the head has then sunk considerably into the pelvis, as in primiparae it is already in the pelvis before labour commences, and in multiparae it enters it early in the first stage as a rule. It used to be thought that the bregma first presented. Roederer held that the occiput presented, and Naegele described the upper part of the anterior parietal bone as first meeting the finger. So far Naegele was right, since, as the finger enters under the short anterior wall of the pelvic canal, it certainly first

meets the anterior parietal bone; but when the finger passes on to the centre of the canal, *i.e.*, into the axis of the pelvis, it finds there that part of the sagittal suture which lies between the parietal eminences. Thus the first part to present in normal labour is the *vertex*. Naegele held that the head was tilted to one side, so causing a lateral part to present, whereas the true reason why the finger first feels a lateral part is the shortness of the anterior pelvic wall.

Position.—This is the relation of the presenting part, be it head, breech, or shoulder, to the pelvis of the mother. We have here to consider the various positions of the head in vertex presentations. In these the antero-posterior plane of the head does not lie in either of the direct diameters of the pelvis, but approaches one of the oblique diameters. The head has thus an obliquity called the **Solayres obliquity.** This may be expressed by saying that the occiput is found to lie in one of the four quadrants into which the plane of the brim is divided by the transverse and conjugate diameters. Accordingly we have four oblique positions for vertex presentations.

First, the occiput opposite the left ilio-pectineal eminence; second, the occiput opposite the right ilio-pectineal eminence; third, the occiput opposite the right sacro-iliac joint; and fourth, the occiput opposite the left sacro-iliac joint. The head enters the pelvis in these four positions with no obliquity other than the Solayres obliquity, the occipito-frontal plane of the head being practically parallel to the so-called plane of the brim, and the anterior and posterior fontanelles being palpable with equal ease.

Roederer's obliquity consists in the occiput being lower than the sinciput. Roederer thought that this obliquity was normally present at the beginning of labour, and accordingly described the occiput as presenting. The truth is that this obliquity appears as labour proceeds, the occiput dipping below the sinciput in the movement

known as flexion, and the posterior fontanelle becoming more easily palpable than the anterior.

Michaelis obliquity consists in the sinciput being lower than the occiput. This obliquity does not occur at all in normal labour, but appears in some abnormal mechanisms, the sinciput dipping below the occiput, and the anterior fontanelle becoming more easily felt than the posterior.

Naegele obliquity consists in one side of the head being lower than the other. Naegele thought that this obliquity was present at the beginning of normal labour, and accordingly described the anterior parietal bone as presenting. But this is not so, and Naegele obliquity does not occur as a rule in normal labour, though it does appear in some abnormal mechanisms, one parietal bone dipping below the other and more of it becoming palpable below the girdle of resistance.

In ordinary cases then, at the beginning of labour, the vertex presents, and Solayres obliquity is present, but no other obliquity.

Nomenclature.—The four oblique positions of the head in vertex presentation are named according to the position of the occiput, this being the "denominator." They are written and referred to for brevity by the initial letters of their names.

1.	Left Occipito-Anterior, . .	L O A.
2.	Right Occipito-Anterior, .	R O A.
3.	Right Occipito-Posterior, .	R O P.
4.	Left Occipito-Posterior, . .	L O P.

Frequency.—The long or antero-posterior diameter of the head usually lies in the right oblique diameter of the pelvis. This is because the presence of the rectum in the left posterior quadrant of the pelvis shortens the left oblique diameter, and perhaps also because the uterus, gravid or non-gravid, has a natural twist on its long axis which brings its left border toward the front.

The back of the child is more frequently toward the front than toward the back of the mother.

Taking these two statements together, we see that the 1st and 3rd positions, the L O A and the R O P, are common, while the 2nd and 4th, the R O A and the L O P, are rare.

The 1st or L O A is more frequent than the 3rd or R O P, and the 2nd or R O A is more frequent than the 4th or L O P.

Thus the order of frequency is L O A; R O P; R O A; L O P.

The positions in 3491 cases were :—

L O A,	2262.	R O P,	1217.
R O A,	8.	L O P,	4.

The following table[1] gives the percentages as recorded by various authors :—

Position.	Naegele.	Naegele, jun.	Simpson & Barry.	Dubois.	Murphy.	Swayne.
L O A	70	64	76	70	63	86
R O P	29	32	25	25	16	1
R O A	...	...	.2	2	16	9
L O P	..	...	·5	.6	4	2

A fair average statement of the relative frequency per cent. is :—

L O A, 72. R O P, 21. R O A, 5. L O P, 2.

It is often stated otherwise, for instance as :—

L O A, 65. R O P, 20. R O A, 10. L O P, 5.

It must be remembered that R O P cases usually change

[1] Leishman.

during labour into R O A cases, and are liable to be recorded as R O A if not examined until labour is somewhat advanced. This fact tends to increase the frequency of the R O A position in the minds of some observers. (See page 221.)

Diagnosis of Position. — Abdominal palpation usually reveals the position of the child's back, and from this it is known that the occiput points left or right, backwards or forwards. Thus the position should be known long before the cervix is sufficiently dilated to admit of a satisfactory vaginal examination. When palpating the head through the dilated os the sagittal suture will lead to the two fontanelles, the anterior being recognised by its lozenge shape, the posterior by its triradiate form. Pressing on the posterior fontanelle, the angle of bone which dips below the other two is the tip of the occipital bone, whose position is thus known. The time most favourable for this examination is immediately after rupture of the membranes.

MECHANISM OF LABOUR IN VERTEX PRESENTATION.

Descent of the head goes on simultaneously with the other movements now to be described, and it is not necessary to include it as a separate movement. It must be remembered that the upper part of the pelvis is practically a straight canal. A plane may be imagined drawn through the lower margin of the pubic symphysis parallel to the plane of the brim. Through the part of the canal above this plane, the head, if not large, may descend in the position described as its original presentation, that is with Solayres obliquity, but the occipito-frontal plane of the head practically parallel to the plane of the brim. After this the mechanism of labour begins and is usually described

as consisting of the following movements of the head together with descent[1]:—

1. Flexion. 2. Internal Rotation. 3. Extension. 4. External rotation.

Flexion.

Nature.—It has frequently been stated on theoretical grounds that before this movement the child's head is not bent upon its chest with the chin touching the sternum, and flexion has been defined as a bending of the head forward on the chest. But it is not possible to show by clinical methods that the chin is not touching the sternum from the first, and sectional anatomy now shows that it is so (see next chapter). Therefore our ideas of flexion must be confined to the head as palpable by the vagina, and must not stray above the girdle of resistance to the child's chin and sternum, which as yet remain completely concealed from the clinical observer. The facts are, that as labour goes on the posterior fontanelle becomes more and more palpable, the anterior fontanelle passing out of reach. The occiput, that is to say, dips below the sinciput and comes to present instead of the vertex. Thus flexion may be defined as the appearance of Roederer obliquity, or as a change of presentation from vertex to occiput.

Place.—The movement occurs where the head first meets resistance from narrowness of the bony parts, or resiliance of the soft parts, and thus may take place at the brim, or not until the head reaches the pelvic floor.

[1] The term Synclitism has been used by Hodge, Keuneke and others to imply an alleged movement whereby certain planes of the foetal head are always kept parallel with certain planes of the pelvis. The planes both of head and of pelvis are variously defined. There is no clinical evidence that such synclitic movement occurs, and the evidence of sectional anatomy tends to show that such movement does not occur. We therefore omit further consideration of the subject. See Hart, Selected Papers, Edinburgh, 1893, p. 88, and Duncan, Mechanism of Normal and Morbid Parturition, Edinburgh, 1875, p. 192.

Cause—Lever theory.—Before it was known that the expulsive powers act as a general-contents-pressure, the plastic body of the foetus and the liquor amnii together behaving like a fluid mass, it was thought that the force of the uterine and abdominal muscles was transmitted to the head of the foetus by the spine. Now as the spine is attached to a point nearer to the back than to the front of the head it was stated that the depressing force was applied nearer to the occiput than to the sinciput, and that the occiput was accordingly most depressed, being in fact the short end of a lever. This lever theory of flexion must be opposed for two main reasons. Firstly, it gives a cause for a movement which does not occur—namely, a bending of the child's head approximating its chin to its sternum. For pressure through the spine on the condyles could only flex the head if it were somewhat unflexed, and we know that it is flexed from the beginning of labour. Secondly, it is doubtful if any pressure is transmitted to the head through the spine. For the fundus does not sink during the second stage. The foetus is elongated, and the curved spine of intra-uterine life is straightened. The legs are more or less extended above the breech, and liquor amnii also collects between the breech and the fundus before birth. To understand this subject it is necessary to remember that the term "Flexion" was applied to this movement so named when the movement was supposed to be a flexion of the child's head relatively to the child's body. Now that the movement is understood to be only a movement of the head relatively to the pelvis of the mother, the term flexion is retained, but with a meaning which does not belong to it. This use of an old name with a new meaning is misleading, and it remains to be seen how long the term will be retained in the nomenclature of the mechanism of labour.

Wedge theory.—Lahs imagines tangents drawn to the foetal head where it is in contact with the girdle of resistance,

and points out that, if friction be not regarded, the extremity of the head whose tangent makes the smaller angle with a perpendicular to the girdle of resistance should descend faster than the other. On account of the wedge shape of the head before mentioned (see page 207) it is the occiput which should descend most rapidly during uterine contractions. Between the pains, it is added, when a certain degree of flexion already exists, it will be augmented by the lateral pressure of the sides of the parturient canal, which is for this purpose regarded, somewhat unnaturally, as a cylinder. These two ingenious applications of the principle of "couples" of forces are unnecessary and theoretical. The wedge theory, like the lever theory, is sadly strained when it becomes necessary to explain the rapid descent of the chin in a face case or of the anterior hip in a breech case. These occurrences, like the rapid descent of the occiput in a vertex case, should be explained, not by theories about the presenting part of the foetus, but by facts about the parturient canal.

True Cause.—The anterior wall of the pelvis is smooth and short, the bony structures being lined by a relatively thin covering of soft tissues. The posterior wall is long, and is lined by a relatively large amount of resiliant elastic and muscular tissue. Any part of the foetus which is in contact with the anterior wall is thus exposed to much less resistance than parts passing over the posterior wall. This accounts for the more rapid descent of the anterior part in all presentations and mechanisms, and, amongst them, for the dipping of the occiput, known as flexion in cases of vertex presentation.

Result.—The change of the presenting part from the vertex to the occiput approximates the direction of the long axis of the head to that of the axis of the parturient canal, and thus presents a shorter diameter of the head to the diameter of the pelvis. Just as a man can get a hat on to the back of his head which is too small to fit on the top of

it, so a foetal head can pass through a pelvis, occiput leading, which it could not traverse with the vertex leading. Taking the occipito-frontal diameter of the head as $4\frac{1}{2}$ inches and the sub-occipito-bregmatic as 4 inches, it is obvious that the space gained by flexion is very considerable.

Internal Rotation.

Nature.—This is a movement of the leading part from the side of the pelvis to the front. Thus in normal labour internal rotation may be defined as a movement forward of the occiput, which has assumed the lead during the movement of flexion.

Place.—Rotation takes place when the leading part of the head meets the resistance of the pelvic floor. The posterior segment of the pelvic floor is referred to, as the anterior segment is drawn up out of the way, and offers little resistance.

Cause—Wedge Theory.—It is pointed out by Professor A. R. Simpson that the wedge theory of Lahs for flexion may be applied to explain rotation, as the side of the head slopes gently forwards, but sharply backwards from the parietal eminences. The chin, the hip, the shoulder, and the sinciput all rotate forward under certain circumstances, and they cannot all be said to present suitable wedges, so that the shape of the presenting part can hardly be said to afford a valid explanation of the movement.

Inclined Plane Theory.—The shape of the internal surface of the ischium is said to cause rotation. An elevation runs from a point in the brim near the ilio-pectineal eminence downward and backward to the ischial spine, dividing the lateral wall of the pelvis into anterior and posterior parts. Before and behind this elevation the ischia are described as forming inclined planes which direct the occiput forward and the sinciput backward, turning part of their

downward motive force into rotation about the pelvic axis, like the rifling of a musket barrel transforms into rotation part of the impetus of a conical bullet. The value of this theory is impaired by the fact that rotation occurs as usual in pelves so deformed that the most scientific imagination could not discover in them the necessary inclined planes. Further, the rotating parts are, in the case of the breech and the shoulder, so plastic that they would be moulded rather than rotated by the ischia.

True Cause.—Hart's view of the cause of internal rotation is briefly as follows. The posterior or sacral segment of the pelvic floor is a strong and resiliant structure, which is pressed down by the head during each pain, and, as the pain passes off, returns by its own elasticity towards its former position, pressing the head upwards and forwards again. Now the descending head strikes asymmetrically upon this resisting structure. As the occiput leads after flexion has occurred, it strikes one lateral half of the sacral segment before the sinciput strikes the other half, and, in the rebound of the pelvic floor after each pain, the occiput is accordingly pushed upwards and forwards by the lateral half against which it has been pressed. Thus after each pain the occiput is forced more and more to the front of the pelvis. When the occiput looks directly forward the head lies symmetrically in the pelvis, and its halves are pressed with equal force against the halves of the pelvic floor, so no further rotation occurs.

If the sinciput lead instead of the occiput, it strikes one-half of the sacral segment before the occiput strikes the other half. In this case the sinciput is rotated forward till it lies under the pubic arch, the occiput passing back to the hollow of the sacrum (mal-rotated occipito-posterior).

To see the full beauty of this view we must glance at presentations other than the vertex. In most face cases the chin first strikes one half of the pelvic floor, and is rotated to the front, but if the forehead dip and strike one-

half of the pelvic floor before the chin strikes the other half, then the forehead comes to the front, the chin passing into the hollow of the sacrum (mal-rotated mento-posterior). After the birth of the head, the shoulder which is lowest is rotated to the front. In breech cases, the lower or leading hip comes to the front, and in transverse cases the leading part comes to the front. To quote Hart's words:[1]

"1. Whatever part of the foetal head or trunk first strikes a lateral part of the sacral segment is rotated internally to the front.

"2. No part of the foetus is ever rotated directly into the hollow of the sacrum. The passage of the occiput into the hollow of the sacrum in its so-called posterior rotation is exactly equivalent to the passage of the sinciput into the hollow of the sacrum in normal rotation, and should be excluded from descriptive terminology as the latter is.

"3. The direction of rotation may be predicted in any case by noting what part first strikes persistently a lateral half of the sacral segment."

Result.—The effect of rotation is to allow the head, which enters the pelvis with its long diameter in a long diameter of the inlet, to leave the pelvis with its long diameter in the long diameter of the outlet.

Extension.

Nature.—This movement is usually described as a reversing of flexion in which the child's chin leaves the sternum while the head rotates about a transverse axis passing through the pubic symphysis. This is said to begin when the head meets the resistance of the pelvic floor. Now there is no clinical evidence of this; and all frozen sections of the second stage show the chin closely approximated to the sternum. Our views on extension, like those on flexion, must therefore be modified. We have seen that

[1] Selected Papers, Edin. 1893, chap. ix.

after flexion has occurred, the presenting part, or that in the area surrounded by the girdle of resistance, is the occiput. The posterior fontanelle, in fact, is the presenting point after internal rotation has occurred. When the head has descended so far that the vulvar aperture forms the girdle of resistance, and part of the head becomes visible, the posterior fontanelle is still in the centre of that part. The head continues to advance, the lower part of the occiput passing under the pubic arch, while the sinciput passes over the distended perineum, and no part of the head is arrested during the whole process. Thus extension, as observed clinically, is reduced to a slight undoing of flexion.

Place.—This occurs as the head is escaping from the vulvar aperture, but not before.

Cause.—When the occiput is outside the vulva it is free from pressure from the front, but the elasticity of the pelvic floor still presses forward and upward the parts of the head still within the parturient canal. To this elasticity of the perineal structures the extension which occurs must be ascribed.

Result.—The movement results in the escape of the head.[1]

External Rotation.

Nature.—When the head has escaped, the face is noticed to turn again to one side, usually to that side toward which it looked before internal rotation occurred. The movement has therefore been called restitution. Internal rotation of the head being not quite complete, and the occiput at its escape looking, say, to the left of the middle line of the mother, the right shoulder is in advance of the left shoulder, is rotated to the front, and passes under the pubic arch; the

[1] It has been humorously remarked that the result of extension is a tear of the perineum—a fact often observed clinically—and important in management at this point.

left shoulder passes over the perineum, the child's occiput looking to the mother's left side again in the movement of restitution. If the shoulders descend level, the left shoulder may come forward, when the child's occiput will turn to the right. In this case, external rotation is not restitution, but a continued movement in the same direction as internal rotation.

Cause.—The shoulder which first strikes one lateral half of the pelvic floor is rotated to the front, and as the head is attached to the body, it also rotates.

Result.—The effect of rotation of the shoulders is to allow the thorax, which enters the pelvis with one shoulder at each side, to escape from the pelvis with one shoulder anterior and the other posterior, the transverse or long axis of the thorax thus being adapted in turn to the transverse of the brim and the antero-posterior diameter of the outlet.

Mechanism in Occipito-Posterior Cases.

In the positions known as the R O P and L O P there are some peculiarities in the mechanism of labour.

Long Internal Rotation of Occiput forward.—Thus in the R O P position the occiput points to the right and backward, the sinciput to the left and forward, Solayres obliquity alone being present. If Roederer obliquity now appears in **flexion**, the posterior fontanelle becoming more palpable, the occiput strikes the right lateral half of the pelvic floor before the sinciput strikes the left half. The occiput is accordingly rotated to the front. But it has to rotate through $\frac{3}{8}$ of a circle—that is, through $\frac{1}{8}$ before the head comes to lie in the transverse of the pelvis, and then through $\frac{1}{4}$ before the occiput looks to the front. Thus the occiput performs a **long rotation** from the sacro-iliac joint round to the pubic symphysis, instead of, as in R O A cases, a short rotation of about $\frac{1}{8}$ of a circle from the ilio-pectineal eminence to the

pubic symphysis. It is plain that, when the first $\frac{1}{4}$ circle of this long rotation has occurred, the occiput looks forward and to the right, and the head is in the R O A position. Thenceforward the mechanism proceeds as in cases originally R O A.

Short Internal Rotation of Sinciput forward.—But if, in the R O P position, flexion does not occur, but the sinciput

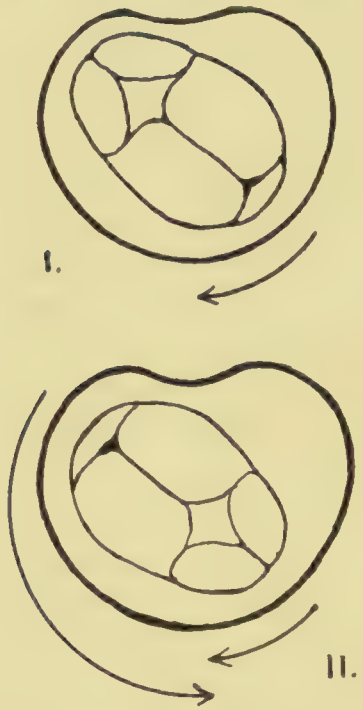


FIG. 30.—Diagram to show the difference between occipito-anterior and occipito-posterior positions as regards internal rotation.

I. Occipito-anterior—occiput rotates to the front through $\frac{1}{8}$ circle.
II. Occipito-posterior—occiput rotates to front through $\frac{3}{8}$ circle, or else sinciput rotates to front through $\frac{1}{8}$ circle.

descends in advance of the occiput in **extension**, then the sinciput strikes the left lateral half of the pelvic floor before the occiput strikes the right half. If this occur, the sinciput is rotated to the front through about $\frac{1}{8}$ of a circle, that is to say, **short internal rotation** of the sinciput to the front

occurs. The occiput, of course, has to pass back into the hollow of the sacrum, and the head now being symmetrically placed as to the pelvic floor, no further rotation occurs. Thus arises the malrotated or persistent occipito-posterior case. The mechanism continues, extension being replaced by **flexion**. The occiput advances and passes over the perineum, while first the forehead, then the face, and lastly the chin pass under the pubic arch. **External rotation** then occurs in either direction as the leading shoulder comes to the front. The L O P position is exactly similar, as the occiput may come to the front in long rotation, turning the case into an L O A, or the sinciput may come to the front in a short rotation, the case ending as a malrotated or persistent occipito-posterior.

Cause of malrotation in Occipito-posterior cases.—If flexion occur at the proper time, long rotation of the occiput follows, and the case becomes occipito-anterior. But if extension occur instead of flexion the sinciput goes to the front in short rotation, and the case becomes persistent occipito-posterior. Now flexion occurs when the head is large, and cannot travel down the pelvis with its occipito-frontal diameter parallel to the plane of the brim, but can do so on substituting the sub-occipito-bregmatic plane of the head. Full-sized heads, therefore, perform the long rotation. When the head is small, however, and can lie in the pelvis with its occipito-frontal plane parallel to the brim, the sinciput may dip below the occiput. For it lies against the smooth short anterior wall of the pelvis, and can easily slip past it in a movement of extension, just as the occiput does in flexion in occipito-anterior cases. Thus it is small heads, or at least those with a small occipital region, in which flexion is replaced by extension, and long rotation of the occiput by short rotation of the sinciput to the front. This is found to be true clinically, by measurements taken after the effects of head moulding have passed away.

Summary of Mechanism in Vertex Presentations.

I. Left Occipito-anterior. First in order of frequency. L O A.

1. **Flexion.** Occiput dips.
2. **Internal Rotation.** Occiput comes to front through $\frac{1}{8}$ circle from left.
3. **Extension.** At birth of head.
4. **External rotation.** Occiput to left in restitution.

II. Right Occipito-anterior. Third in order of frequency. R O A.

1. **Flexion.**
2. **Internal rotation.** Occiput comes forward through $\frac{1}{8}$ circle from right.
3. **Extension.**
4. **External rotation.** Occiput to right in restitution.

III. Right Occipito-posterior. Second in order of frequency. R O P. Two mechanisms may occur.

Most frequently—

1. **Flexion.** Occiput dips.
2. **Long internal rotation** of occiput forward through $\frac{3}{8}$ circle from right.
3. **Extension.**
4. **External rotation.** Occiput to right in restitution.

Less frequently—malrotated occipito-posterior.

1. **Extension.** Sinciput dips.
2. **Short rotation** of sinciput forward through $\frac{1}{8}$ circle from left.
3. **Flexion.** Occiput passes over perineum.
4. **External rotation** in either direction.

IV. Left Occipito-posterior. Fourth in order of frequency. L O P. Two mechanisms may occur.

Most frequently—

1. **Flexion.** Occiput dips.
2. **Long internal rotation** of occiput forward through $\frac{3}{8}$ circle from left.
3. **Extension.**
4. **External rotation.** Occiput to left in restitution.

Less frequently—malrotated occipito-posterior.

1. **Extension.** Sinciput dips.
2. **Short rotation** of sinciput forward through $\frac{1}{8}$ circle from right.
3. **Flexion.** Occiput passes over perineum.
4. **External rotation** in either direction.

Head Marking and Head Moulding.

Caput Succedaneum. — During labour the scalp, where most free from the pressure of the maternal structures, becomes reddened, congested, and swelled by the transudation of serum from its vessels. This produces a rounded elevation of the scalp, resembling elevations of the skin caused by the use of a dry cupping glass. For as the atmospheric pressure on the skin is equal, except inside the cupping glass, so the intra-uterine pressure on the skin of the foetus is general, except over the free part within the band gripped by the girdle of contact. This freedom from pressure is more marked after than before the rupture of the membranes; and as the posterior wall of the parturient canal exercises throughout more pressure on the foetal parts than does the anterior wall, the caput succedaneum is more pronounced toward the anterior than toward the posterior side of the pelvis. The capillary walls may give way, allowing blood to escape into and redden the swelled tissues of the caput. The condition must be distinguished from

cephalhaematoma, in which there is effusion of blood under the scalp, extending over one or more bones of the skull, but confined to their surfaces at the sutures.

Now as the presentation changes during labour from vertex to occiput, so the position of the caput succedaneum changes as successive parts of the scalp become surrounded by the girdle of resistance. Thus a **primary caput** is formed at the vertex by the pressure of the dilating os, and a **secondary caput** over the occiput by the pressure of the

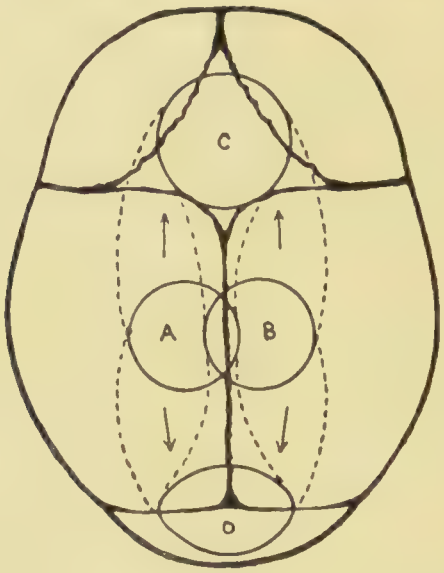


FIG. 31.—Diagram of various positions of the Caput Succedaneum.

A and B are the positions of the primary caput, according as the left or the right parietal is anterior at the beginning of labour.

D is the position of the secondary caput in all cases where the occiput has rotated to the front.

C is the position of the caput in malrotated occipito-posterior cases, *i.e.*, where the sinciput has rotated to the front. (This must not be confused with the caput in face cases.)

distended walls of the vagina, and by the vulvar outlet. A band of elevated reddened scalp crosses the skull from primary to secondary caput, and shows the successive positions of the parts freed from pressure during flexion and

internal rotation. As above mentioned, the caput forms better to the front than to the back of the presenting part, so the **primary caput** is seen a little to one side of the vertex—that is to say, upon the upper part of the anterior parietal bone. This is the right parietal in left occipito cases, and the left parietal in right occipito cases. Thus in the common L O A the primary caput is over the upper part of the right parietal, a reddened band passes downwards and backwards towards the middle line, and the secondary caput is over the posterior fontanelle. In malrotated or **persistent occipito-posterior** cases the **secondary caput** succedaneum is over the anterior fontanelle, which becomes the presenting part when the sinciput performs short rotation forward. The caput succedaneum begins to disappear as soon as labour is over, and should therefore be observed immediately if it is desired to trace from it the mechanism which has occurred.

Shears.—The shears to which the head is exposed during labour produce marked distortions, which pass away gradually after birth, leaving often a slight asymmetry, which is not due to pressure, but to a natural inequality of growth. In ordinary labours the head is exposed successively to two principal shears, the first being lateral, while the second elongates the head in its longer diameter by pressure approximately in the direction of the sub-occipito-bregmatic. For before rotation occurs the margin of the posterior parietal is pushed, by the elastic posterior pelvic wall, under the anterior parietal. After rotation the margins of the frontal bones are pushed under those of the parietals to a certain extent. The sub-occipito-bregmatic and occipito-frontal diameters are shortened. The occipito-mental diameter is not much changed; but the maximum diameter—namely, that from the chin to a point on the sagittal suture above the tip of the occiput—is much increased.

In occipito-posterior cases, persistent through malrotation, the head moulding is very different. The occiput is

flattened, and the region of the bregma is raised. The occipito-mental and occipito-frontal diameters are much shortened, as is the true maximum diameter, the sub-occipito-bregmatic diameter being greatly elongated.

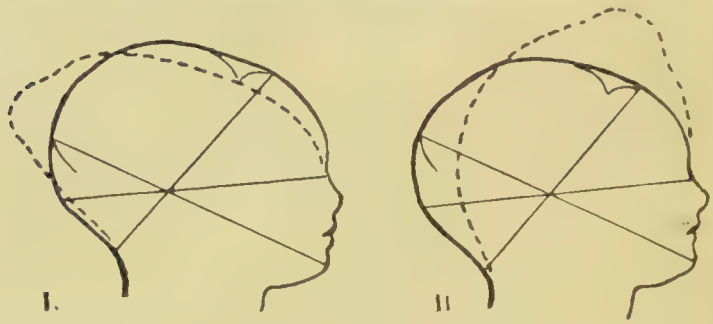


FIG. 32.—Diagram of head moulding and caput.

I. Ordinary case. II. Persistent Occipito-posterior.

The plain line gives the unmoulded form of the head. The o.m. the o.f. and the s.o.b. diameters are shown, also the bregma and the tip of the occiput. The dotted line shows the moulding and the position of the caput in each case.

When antero-posterior pressure reduces the antero-posterior diameters of the head, the frontal bones and the occipital are pushed far under the parietals. The transverse diameters are not increased appreciably by this process. The compensation necessary to make space for the cranial contents is due to an increase in vertical diameters, the parietal bones being farther removed than usual from the base of the skull.[1]

[1] R. Milne Murray, Edin. Med. Journ., Nov. 1888.

CHAPTER XIII.

SECTIONAL ANATOMY OF LABOUR.

THE previous chapters contained a description of the clinical phenomena of labour, and a statement regarding the function as a mechanical process. This statement represents a mass of opinion which has gradually grown up, partly founded on clinical observation and partly arrived at by passing the dried foetal head through the cavity of a dried pelvis.

During the last twenty years new light has been thrown on the subject of labour by the study of sections of the frozen bodies of women who have died during pregnancy, labour and the puerperium, and by the examination of uteri removed by Porro's operation. Many of the results gained confirm those arrived at by clinical observation, others are opposed to views previously held; all have an important bearing on the anatomy, on the physics, and less directly on the physiology of labour. In the books of the future the results of sectional anatomy will doubtless be incorporated with, and will partly replace, the classical description of labour. At the present moment, however, the classical view is taught and examined upon complete, while recent work is demanding the attention of teachers, students and practitioners. A separate chapter is therefore inserted, giving a brief summary of the facts revealed by sectional anatomy up to the present time, and of some of the thought based upon them.

The subject of the mechanism of the third stage of labour is included in this chapter, as apart from the facts

noted in our clinical description, all we know of the third stage has been learnt from sections, by passing the hand into the uterus during the third stage, and by marking in some way the presenting part of the placenta and membranes.

Before Labour.

Sections by Braune; [1] Waldeyer; Pinard and Varnier (two); Barbour and Webster; Braune and Zweifel—all later than 7½ months. Earlier sections by Webster and others.

Peritoneum. — During pregnancy the growing uterus raises the peritoneum in front and behind, and separates the layers of the broad ligament on each side to some extent. The utero-vesical pouch is not obliterated, as at the end of pregnancy the peritoneum dips between the uterus and the bladder, and covers more or less of the surface of the latter. **The bladder**, though still a pelvic organ, is seen, in some sections, to be slightly raised, and its fundus may rise above the brim. Thus the lowest dip of the peritoneum in the middle line in front of the uterus is about at the level of the brim, though it may be an inch above or below it. The Pouch of Douglas preserves approximately its usual position, the peritoneum passing from the cervix on to the posterior vaginal wall, and so on to the rectum. The lowest dip of the peritoneum behind the uterus in the middle line is from 3½ in. to 5 in. below the level of the brim.

On each side there is a **triangular space** within which the uterus is not covered by peritoneum, but is in contact with connective tissue alone. The apex of this triangle is 5 in. above its base, which is 3½ in. in length, and is at the level of the ischial spines and the lower margin of the pubes. This is figured by Barbour, who also finds that

[1] See Fig. 46, Waldeyer's Section "before labour," which illustrates this summary.

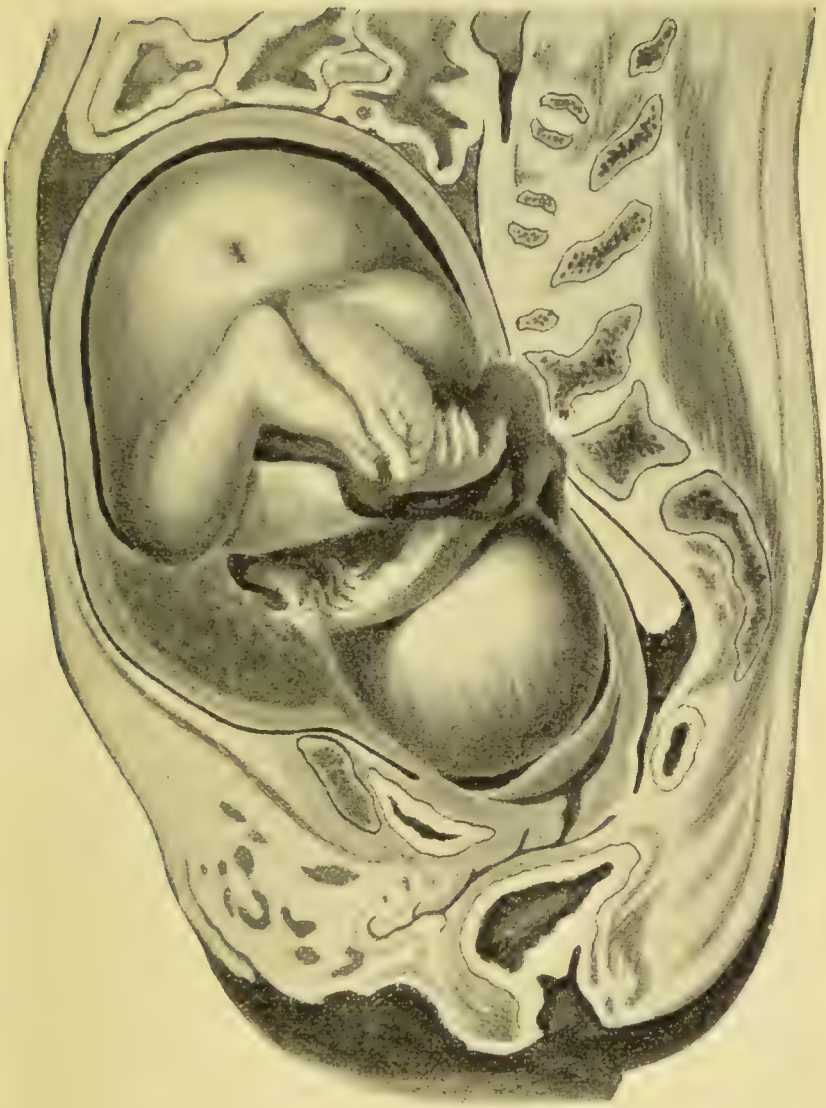


FIG. 33.—First Stage, early. From Winter's Section. Os internum opened; membranes partly separated from lower-segment; bladder in pelvis; partial placenta praevia; its lower part compressed by foetal head, which is fully flexed; note foetal attitude, and short ovoid formed; note dip of peritoneum in front and behind; uterus moulded on pubes and spine; head lies in the transverse, occiput to right. Subject a ii-para, died of eclampsia, full time. See page 237.

connective tissue is abundant between bladder and uterus and in the broad and utero-sacral ligaments. The uterus is thus covered by peritoneum behind, but the sides and front of that part of the organ which is within the pelvis are in contact with connective tissue.

The **ureters** enter the pelvis just in front of the sacro-iliac synchondroses, and are protected by about 1 cm. of venous and cellular tissue. They describe a curved course, crossing the sacro-sciatic notch and the ischium, and entering the bladder opposite the lower part of the obturator foramen. Barbour, who describes these facts, states that the only point where the ureters could be pressed upon injuriously during labour is that where they cross the ischial bones just above the spines.

Pelvic floor.—The structures in the pelvic floor, with the connective tissue separating them, form a thick mass of resiliant tissue, through which the vagina runs. This appears in sections as a slit passing upwards and backwards, at an angle of about 60° with the horizontal, or nearly parallel to the conjugate of the brim. It divides the pelvic floor into two portions, each roughly triangular in shape. The anterior or pubic segment has its base loosely attached to the pubic bones. It has the peritoneum above and the anterior vaginal wall below, and contains the bladder, urethra, and retropubic fat with connective tissue. The posterior or sacral segment has its base firmly attached to the sacrum and coccyx. The posterior vaginal wall bounds it above, while, below it, is the skin of the perineum with the anus and the skin behind it. Thus the posterior segment contains at its apex the perineal body, behind this the anal canal and part of the rectum. From the tip of the coccyx to the posterior margin of the vaginal outlet measures about 3 in. The sacral segment is about 2 in. thick. The vaginal slit is about $3\frac{1}{2}$ in. in length, its anterior wall being about an inch shorter than the posterior. The pubic and sacral segments of the pelvic

floor are closely apposed before labour, the anterior and posterior vaginal walls being in contact.

Cervix.—The cervical canal is not dilated and measures 1 to 1½ in. in length (3.6 cm. average). The cervix is increased in size by growth of muscular and connective tissue.

Lower-Uterine-Segment.—The part of the uterus which is passive during labour can be recognised before it by one or other of the following anatomical features. They are seldom all present in the same section; but two or more are usually noticeable.

1. The lower-uterine-segment is thinner than the rest of the uterus, being 3 or 4 mm. in thickness, while the general wall is 7 to 11 mm. The muscle fibres are arranged in longitudinal plates which are easily separable from one another. Two main layers are seen, their fibres running to the vaginal wall and to the vaginal portion of the cervix respectively.

2. The peritoneum can easily be stripped from the utero-vesical pouch up to a line of firm attachment, 5 to 7½ cm. above the upper end of the cervical canal. The peritoneum is loosely attached to the posterior vaginal wall and cervix, and for 3 to 4 cm. of the posterior wall of the body of uterus; but the line of firm attachment is lower behind than in front.

3. A large vein, the coronary vein, frequently runs transversely round the uterine wall at the upper limit of the lower-uterine-segment, in which the arteries are less numerous and less tortuous than elsewhere.

4. The membranes are loosely attached over the lower-uterine-segment.

The decidua lining this portion of the uterine cavity is quite the same as that of other parts, having a compact superficial layer, spongy layer and deep layer. The transition between cervical mucosa and uterine mucosa may be abrupt or gradual. The occurrence of labour, at any time during pregnancy, makes obvious the presence of a lower-uterine-segment, by causing the formation of a retraction

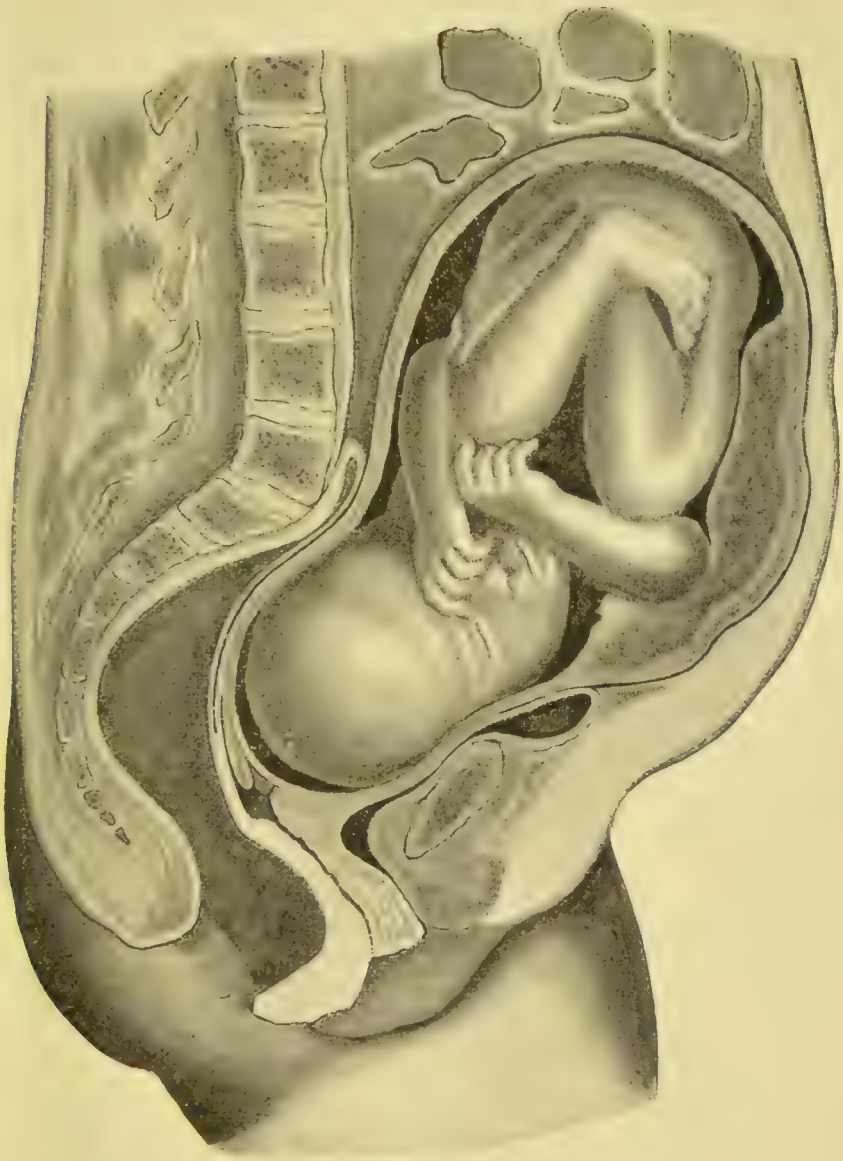


FIG. 34.—First Stage. From Saexinger's Section. Cervix opened up; bladder partly above symphysis; lower-segment thinned, but no retraction ring formed; foetal ovoid lengthened, but head still fully flexed. Placenta on anterior wall. Note dip of peritoneum in front and behind. The conjugata vera is only 3.68 in.; so the head lies in the transverse, occiput to the left. Subject a i-para, died from sepsis at eighth month. See page 237.

ring at its upper limit, and by rendering more obvious the above anatomical peculiarities.

The Uterus is moulded on the surrounding viscera, being impressed by the vertebral column, and by the pubes. The fundus is 9 to 11 in. above the pubic symphysis and is opposite the first or the second lumbar vertebra. The inside measurement from cervix to fundus is about 9 to 10 in. The internal area of the uterine wall is about 200 square in. The thickness of the wall varies between 5 and 10 mm., averaging 7 mm. This thickness is maintained in front down to within 5 or 6 cm. of the upper end of the cervical canal, at which point the wall begins to thin into the lower-uterine-segment. The posterior wall maintains its thickness almost down to the cervix. Numerous sinuses are visible in the uterine wall.

The placenta is about $\frac{1}{2}$ in. to 1 in. thick, its diameter is about 7 in., and it occupies one fifth of the area of the uterine wall.

The foetus has its back arched and limbs flexed so that its general outline is a short ovoid. The head is flexed so that the chin rests on the sternum.

First Stage.

Sections by Barbour, Schroeder, Barbour and Webster, Testut and Blanc, Pestalozza, Pinard and Varnier, Tibone, [1] *Winter (two), Saexinger.*

Peritoneum.—The disposition of the peritoneum is not known to be appreciably altered during the first stage.

The Bladder is more or less pulled upwards; and though it may remain a pelvic organ, some portion of it is usually found above the level of the brim.

With the bladder, the cellular tissue and the anterior vaginal wall are also raised, the whole anterior segment of the **pelvic floor** being pulled upwards. The anterior

[1] See Winter's Section, Fig. 33; and Saexinger's Section, Fig. 34.

vaginal wall is not increased in length to any great extent, while the posterior vaginal wall is gradually elongated as the posterior segment of the pelvic floor is depressed.

The Cervical Canal is gradually expanded.

The Lower-Uterine-Segment is thinned, elongated, and opened out below into a canal continuous with that of the cervix. The os internum is lost to view, the junction of cervix and lower uterine segment being apparent only upon microscopic examination of the mucosa. The upper limit of the lower uterine segment is rendered increasingly plain by the formation of a retraction ring.

The Body of the Uterus after the escape of the liquor amnii is moulded to the body of the foetus, lying on the vertebral column between pains, but during pains erected from it, so that the long axis of the uterus more nearly coincides with the axis of the brim. The wall above the retraction ring is 2 to 3 times as thick as it is below the ring.

The membranes are separated from the lower-uterine-segment.

The foetus.—The head remains flexed and the chin closely pressed on the sternum. Synclitism is not observed to be present in any section; but the reverse of Naegele obliquity is usually found, the posterior parietal bone being low, so that a greater part of the posterior than of the anterior parietal is below the brim.

Second Stage.

Sections by Braune, Chiari,[1] *Chiara,*[2] *Barbour and Webster, Zweifel (two), Von Mars.*

Peritoneum.—In front of the uterus the lowest dip of the peritoneum is about an inch above the brim. The lowest dip behind the uterus is about an inch higher than before labour.

[1] See Fig. 35.

[2] See Fig. 47, Chiara's "second stage" Section, which also illustrates this summary.

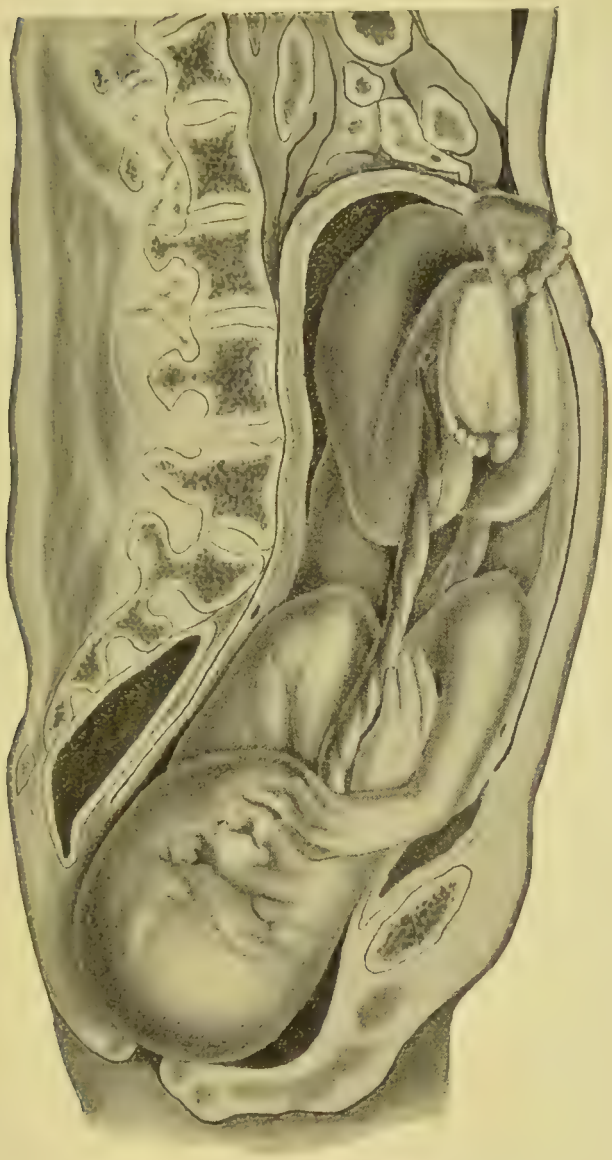


FIG. 35.—Second Stage. From Chiari's Section. The head has descended to the perineum. The coronary vein shows the level of the retraction ring in front and behind. Bladder partly abdominal. Foetal ovoid much lengthened, foetal attitude being undone, but flexion is still maintained. Placenta fundal and posterior. Note peritoneum in front and behind. Membranes are separated from whole lower-segment. Uterus relaxed between pains, moulded on spine, and parallel to it. Section is to left of mid line. Subject a i-para.

The Bladder is now in great part abdominal, a portion still being pelvic. The pelvic floor is completely canalised, its anterior segment being drawn up, while the posterior segment is much depressed. The **anal canal** is opened out and the perineal body is thinned and flattened as the second stage advances. The bony canal is much modified by the **soft parts**.

At the brim the soft parts are	$\frac{1}{2}$ to $\frac{3}{4}$ in.	thick.
In the cavity „ „	$\frac{3}{4}$ to $1\frac{1}{4}$ in.	„
At the outlet anteriorly	$\frac{3}{4}$ to $\frac{7}{8}$ in.	„

The soft parts are so disposed that the antero-posterior diameter of the cavity is longer than the transverse in a plane parallel to the brim passing through the apex of the pubic arch. The antero-posterior diameter continues to increase, the transverse lessening as lower planes are taken.

The parturient canal may be considered as consisting of an upper part extending from the [1] retraction ring to the os externum (the os internum being now practically invisible except on microscopic examination), and a lower part, the vagina. Both these portions of the canal have their posterior wall much longer than the anterior.

The retraction ring is most marked during contraction, and if its position coincides with a depression in the foetus, such as the neck, it becomes very prominent indeed. The peritoneum is loose and the membranes are separated below the ring. The anterior vaginal wall remains 2 to $2\frac{1}{2}$ inches in length, so is not elongated much, while the posterior vaginal wall is 7 inches in length when the head has descended to the perineum.

The fundus rises very slightly during the second stage, and does not sink at all till the head is actually expelled.

The foetus is elongated and narrowed, its general form being in the second stage a longer ovoid than during the

[1] Schroeder and others have termed this the "contraction ring," but Barbour's name, "retraction ring," is more accurate, as the ring is persistent and progressive when once formed.

first stage. The limbs are pressed closely to the body; and the back is straightened, so that there is a separation of the upper and lower extremities. The chin, however, remains firmly flexed on the sternum, in every case sectioned during the second stage.

Third Stage.

Sections by Pestalozza[1] *(two): numerous uteri removed by Porro's operation and P.M., Barbour, Pinard and Varnier, and others.*

These sections show that the **peritoneum** descends again at the completion of the second stage, both before and behind the uterus, the **bladder** sinking into the pelvis with the anterior portion of the pelvic floor. The posterior portion rises into apposition with the anterior, so that the parturient canal at once becomes a mere slit, and has **no actual cavity**.

The **fundus** sinks to about 7 inches above the symphysis, and a considerable portion of the uterus lies within the pelvic cavity. The **lower-uterine-segment** remains thin and flaccid compared with the retracted portion of the uterine wall, which thickens and is lessened in area so as to closely embrace the placenta. There is thus **no actual cavity** within the uterus during the third stage, the placenta and any blood clot which may be present occupying the whole space between its walls. The part of the wall to which the placenta is attached does not retract and thicken so rapidly as the rest of the uterus. The mass measures 8 or 9 inches in length, and $3\frac{1}{2}$-4 inches antero-posteriorly. The wall in the placental area is about $\frac{1}{4}$ in. thick, the rest of the wall being about an inch thick, the placenta accounting for the remaining $2\frac{3}{4}$ inches of the antero-posterior diameter of the mass.

The marked thickening is mainly due to lateral retraction and contraction of the uterus, as the placenta retains nearly

[1] Fig. 36.

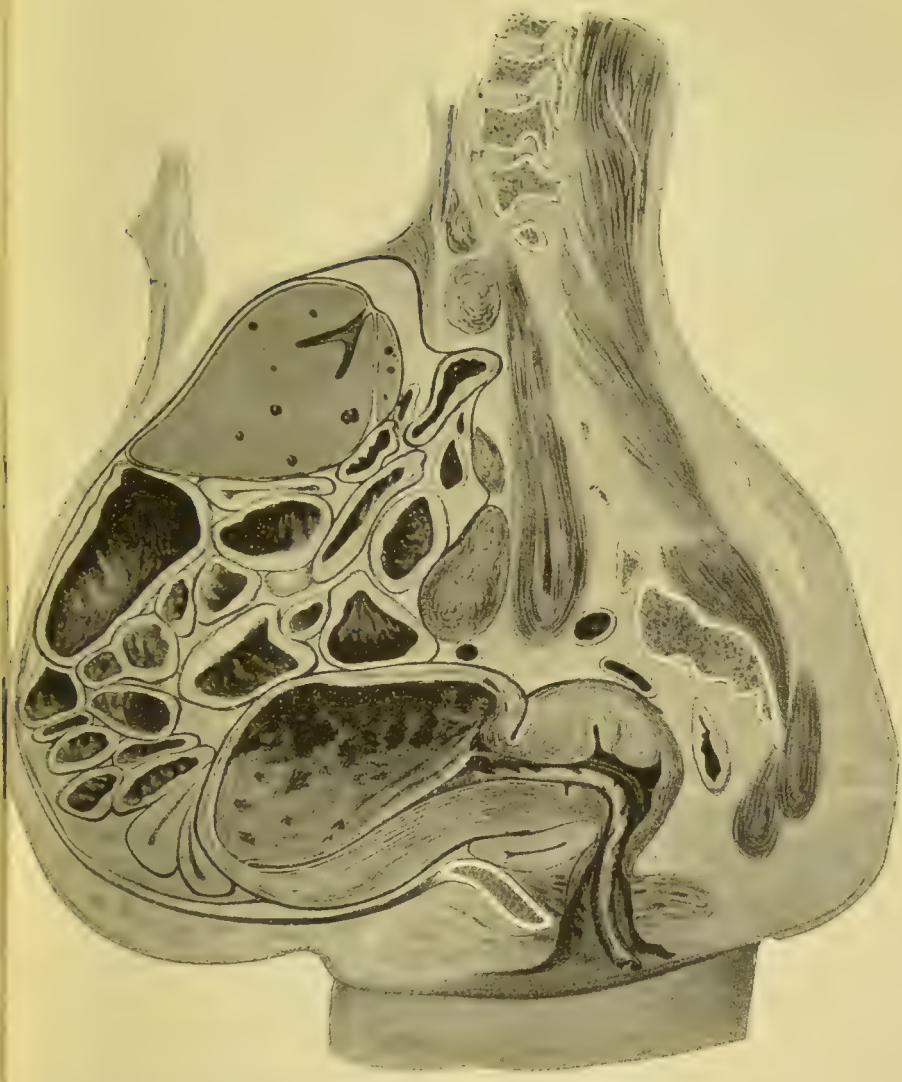


FIG 36.—Section by Pestalozza of body frozen erect, after death at the beginning of the third stage. The placenta is *in situ* and separation has not begun. Its attachment measures $8\frac{1}{3}$ in.; the uterus measures 8 in. × 4; Anterior wall, 1 in.; Placenta, $2\frac{3}{4}$ in.; Posterior wall, $\frac{1}{4}$ in. thick. No empty space in uterus. The membranes are detached from the lower-uterine-segment. The anteflexion of the uterus and the outline of the abdomen are due to the subject having been frozen in the erect posture. The other sections have been frozen in the dorsal posture. This section was a single pregnancy. Pestalozza's other section was a twin pregnancy, both placentae being shown *in situ*. Figure lent and measurements given by Dr Barbour.

its full diameter of 7 inches measured from above downwards. The placenta remains completely attached in most of the third stage preparations. Where separation has begun it is at the lower margin. One section shows the placenta being expelled, the cord presenting, and a mass of blood clot behind it, as in the rare condition which was described as common by Baudelocque and Schultze. The **fundus** is raised

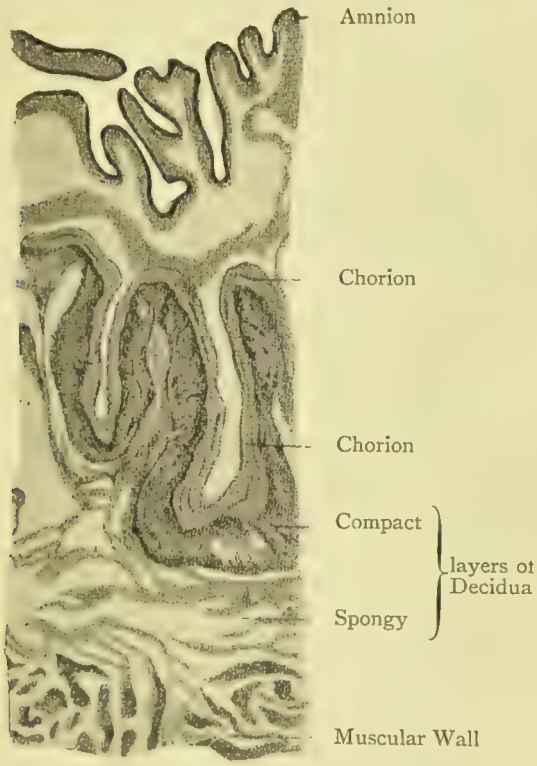


FIG. 37.—Membranes at beginning of Third Stage (Barbour).

somewhat on expulsion of the placenta from the retracting portion into the lower-uterine-segment and vagina.

The **membranes** are, as before, completely separated from the lower-uterine-segment. They are not separated from the rest of the uterine wall; but are held in contact with it by portions of the decidua. Barbour has shown that when the uterine area becomes reduced the mem-

branes are thrown into numerous waves or convolutions. The amnion forms waves of its own, apart from the chorion, so that these two membranes remain in contact only where the crests of the waves meet, the sub-amniotic layer of tissue being stretched and torn. The chorion and the compact layer of the decidua act as one membrane, and together are thrown into a series of waves. Thus the membranes are separated, except where the hollows of the waves remain in contact with the uterine wall. The convoluted membranes form a layer $\frac{1}{8}$ in. thick, lining the uterus. The naked eye can distinguish two layers —one being the folded amnion, the other the folded chorion and compact layer of decidua. The deep layer of the uterine mucosa is seen on microscopic examination, continuous with the muscular wall, and showing no fatty degeneration.

After Delivery.

Sections by Stratz,[1] *Barbour, Barbour and Webster, Webster (several).*

The **peritoneum** is thrown into folds over the bladder and the lower part of the abdominal wall, but not over the uterus. The **bladder** is in the pelvis, its form being triangular or V-shaped, according to the degree of contraction of its wall. The **uterine wall** is $1\frac{1}{4}$ to $1\frac{1}{2}$ in. thick. There is **no empty space** in the uterus, but a little blood clot separates its anterior and posterior walls, and is continuous with thrombi in the vessels of the placental site. The **body of the uterus** measures about 6 inches in length, the cervix about $1\frac{1}{2}$ inches. The **vagina** is found contracted to its usual length immediately after delivery. Webster's series of preparations from the puerperium shows that for three or four days after delivery the uterus does not decrease much in size, and that the sinking of the organ into the pelvis causes pressure on the vessels and so checks haemorrhage.

[1] Fig. 38.

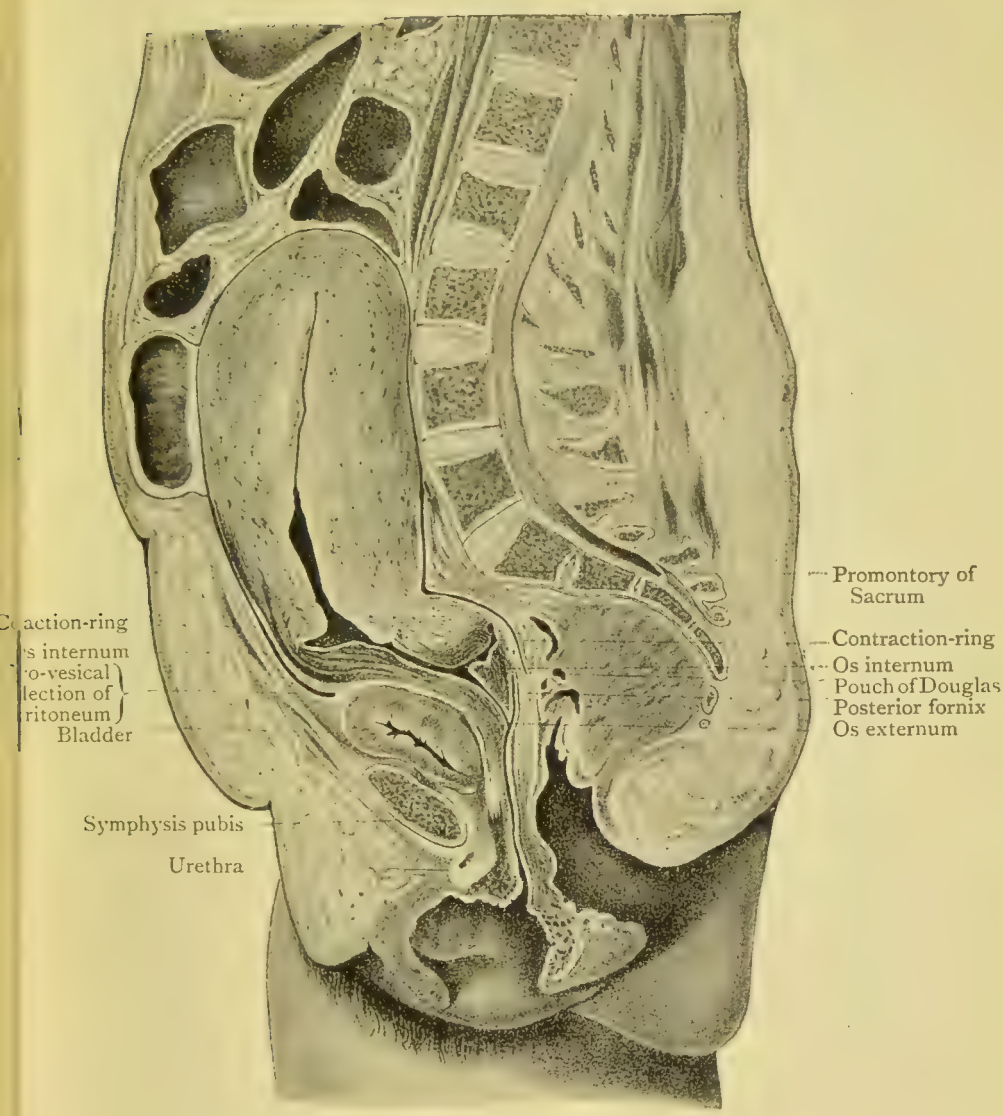


FIG. 38.—From Stratz's Section. This section shows the uterus immediately after delivery. The conjugate is very short, so that the uterus and bladder have not sunk into the pelvis as they usually do after labour. Note the thick retracted uterine wall and the thin lower-segment and cervix. Anterior and posterior uterine walls apposed except where separated by a little blood clot. Vaginal walls in apposition. Subject a i-para, who died within an hour after delivery.

Note on Sectional Anatomy of First and Second Stages.

All the structures concerned in parturition have thus been directly measured, and their relations at different stages definitely ascertained. The soft parts have been shown to modify the form of the pelvic canal to an extent which was not previously realised. The parturient organs have been seen to form a tube divided functionally into two portions at the retraction ring, the upper part active, the lower passive. The foetus is now looked upon as a plastic mass rather than as an elongated rigid body. The new fact that the chin is found against the sternum before and during labour till the end of the second stage materially alters the conception of the movements of flexion and extension. Additional evidence as to the action of the pelvic floor strengthens Hart's position regarding rotation, and weakens previous views on the subject. The ovum then is a plastic mass, ovoid in shape, and broader than the aperture through which it has to pass. Like a fluid it transmits pressure in all directions. It is exposed during labour to pressure on all sides, but least at the lower pole of the uterus. The mass therefore changes in shape, becoming elongated, and elongating the cavity containing it. The upper part remains stationary, the lower part moves in the direction of least resistance. The foetal ovoid being narrowed and elongated to nearly twice its original length, the whole pelvis is canalised, and the foetus occupies both active and passive portions of a curved tube. The upper half of the tube continues to contract, and its content is expelled *en masse.*

Discussion of the Third Stage.

It is about the third stage, however, that present interest is mainly centered. Some years ago Barbour stated that the placenta is not separated till the third stage of labour

has begun; and that the uterus can retract, squeezing the placenta within it till the placental area is reduced to 4 in. by $4\frac{1}{2}$ in., without any separation taking place. He also pointed out that there is *no empty space in the uterus during the third stage*, and that the escape of blood between the placenta and the uterine wall does not occur as a general rule, and is not an essential cause of separation.[1] These conclusions were mainly based on the study of uteri removed by Porro's operation, and they were attacked on that ground by Champneys and others.

The conclusions mentioned have now been confirmed by two complete frozen sections of women who died during the third stage,[2] and by sections of complete uteri removed from the body after death.[3] These conclusions also agree with the well-known clinical facts that bleeding does not normally occur until after the birth of the child, and that retraction may so far diminish the circulation of the placental area that the placenta may be separated thereafter with a very trifling loss of blood, and certainly without the formation of any retro-placental haematoma.

Separation by blood.—As both clinical experience and frozen sections demonstrate that the placenta can be separated without the extravasation of a mass of blood behind it, it is obvious that such blood extravasation cannot be the cause of separation. We may therefore dismiss haemorrhage as *the* cause of separation. It has been put forward by Baudelocque, Schultze, Ahlfeld, Cohn, Stratz, and other German authorities, and therefore has a historical interest. In the rare cases of fundal insertion, haemorrhage may doubtless occur behind the placenta, which is expelled with the foetal surface leading, as described by Schultze, but even in these cases it remains to be proved that the haemorrhage is a cause of the separation.

[1] Edin. Med. Journ., Sept. 1884.

[2] Pestalozza, Anatomia dell' Utero Umano, Milan.

[3] Pinard et Varnier, Etudes d'Anatomie Obstétricale, 1892, Paris.

We are thus left with the conclusion that the muscular action of the uterus in pains of the third stage separates the placenta.

Separation by expulsion or detrusion.—Here we may take one of two views. First is that known as the "detrusion" view, which is that the uterus as a whole contracts and retracts upon the placenta and expels it as a whole, separation being looked upon merely as a necessary part of expulsion. The facts are, that retraction of the uterus till the placental site measures 4 in. by $4\frac{1}{2}$ in. can occur without separation; that the placenta is pressed upon on all sides by the uterus in which there is no empty space; that the compression is mostly lateral, the placenta being thickened to $2\frac{3}{4}$ or 3 in., and narrowed from side to side, while it is very much less compressed from above downwards. Further facts are that separation begins at the lower margin, and that expulsion occurs with the lower margin or a point near it leading.[1] These facts fit well with the theory that the placenta is compressed, like the foetus, into an elongated body, which moves in the direction of least resistance, that is downwards through the retraction ring under pressure from the sides and above.

This method of separation and expulsion in one act may be compared to the separation and expulsion of a submucous fibroid from the uterus, or that of a hydatid mole which has no special area of attachment. To this theory Hart objects that some sections show the placenta partially detached at its lower border, remaining attached above, and he states that, were detrusion the cause of separation, the whole of the placenta should be separated at once. If the placenta were a rigid body this would doubtless be so, but in the case of a plastic mass it seems quite natural that the lower portion should be separated, as it is expelled, before the upper.

Separation apart from and before expulsion.—But the

[1] Expulsion according to Schultze's method being the rare exception.

second view, which distinguishes between separation and expulsion, must be considered. This is, that separation is caused by a disproportion or difference in size between the placental site and the maternal surface of the placenta (or placental area). It is obvious that such a difference can logically arise in two ways, for the placental site may be either larger or smaller than the placental area.

Reduction in size of the placental site beyond that of the placental area was long considered to be a cause of separation. But Barbour has proved that the site and area can together be reduced to an area of $4\frac{1}{2} \times 4$ in. without any separation. He, however, considers that, though no separation occurs before this degree of retraction is reached, there must be a limit beyond which retraction of the placental site is not accompanied by reduction of the placental area, and he holds that the **site becoming smaller than the area** is a true cause of separation. As Barbour allows that "detrusion" is also a true cause of separation, his position is that separation is due to "*diminution in area beyond* $4\frac{1}{2} \times 4$ *in., plus the action of the uterus as a whole on the placental mass.*"

Hart, however, attacks Barbour's conclusions, and considers separation due to disproportion arising through the **placental site becoming larger than the placental area.** He holds that no amount of retraction can separate the placenta, because retraction down to $4\frac{1}{2} \times 4$ in. does not do so, and as the uterus grips the placenta on all sides, no further retraction can reduce the site without at the same time reducing the placenta and the placental area.

Hart's own view takes into consideration the facts of the placental circulation, both foetal and maternal. While the foetus is in utero the placenta is filled with both foetal and maternal blood. When the uterus contracts the placental site and placental area are together reduced, and blood is squeezed out of the placenta. When the uterus relaxes, the placental site and area expand together, blood flowing into

the placenta from both mother and foetus. If the foetus die in utero and the foetal circulation be stopped, the maternal blood still flows in and out of the placenta with the uterine relaxations and contractions, and allows the placenta to follow the alternating reductions and enlargements of the placental site.

After the foetus is expelled from the uterus, uterine retraction is so great that the maternal blood supply is practically cut off from the placenta. But the foetal blood supply continues for a time. Each contraction of the third stage drives the foetal blood out of the placenta, and at each relaxation of the uterus the foetal blood rushes back into the placenta and enables it to expand in harmony with the enlargement of the placental site, so that during the third stage no separation occurs while the foetal circulation continues to reach the placenta.

But when the foetal circulation is cut off from the placenta a change occurs. After a contraction of the uterus has reduced placental site and placental area alike, relaxation of the uterus again enlarges the placental site; but there is now no foetal blood to rush into the placenta, it can no longer enlarge, and thus the placental site becomes larger than the placental area. It is this, according to Hart, which separates the placenta. His position is, then, that the placenta can lessen and expand along with the portion of the uterine wall to which it is attached so long as one or both of its blood supplies—foetal and maternal—are intact: that the placenta with no blood supply can lessen along with the uterine wall during contraction, but cannot expand with it during relaxation: and that separation therefore occurs *during the relaxations of the uterus in the third stage* after the foetal circulation in the placenta has ceased, the maternal blood supply being already stopped by retraction of the uterus. This mechanism of separation, Hart points out, is the same as that which separates the praevial membranes or placenta in the first stage, when their site,

the lower-uterine-segment, is dilated to a larger size than their area.

Summary.—Having then the above theories of placental separation, it remains to choose between them. They may be named :—

Blood Extravasation.—German view of separation.

Detrusion.—Separation with and by expulsion. Accepted by most authorities.

Disproportion.— { Placental site smaller than placental area. Accepted by most authorities.
Placental site larger than placental area. Hart. }

If we agree with Hart that no amount of retraction can cause separation; and with Barbour and others that Hart's view is incorrect, there is no theory left but the detrusion theory, against which there seems to be no valid evidence. The writers who advance blood extravasation behind the placenta as a cause of separation are greatly disagreed as to how the haemorrhage is caused and how it causes separation. As a matter of fact it does not occur as a rule, and therefore cannot be considered as a cause of separation in normal labour.

Whichever theory is favoured, we may summarise the **phenomena of the third stage** as follows :—

The placenta is separated after the birth of the child by the activity of the uterine muscle.

The manner in which the separation occurs is by detrusion or by disproportion in size between the placental site and the placental area, or by a combination of these.

The placenta is expelled from the retracting portion of the uterus by the muscular action of the uterus alone.

It is compressed laterally, and presents by a point at or near the lower margin as a rule; but occasionally it is inverted, and presents by the foetal surface near the insertion of the cord.

The placenta is expelled from the lower-uterine-segment, cervix and vagina by the accessory powers, which may be assisted by gravitation.

The membranes are partly separated by being crumpled into waves, and are completely separated and removed from the uterus on being dragged out by the placenta.

Bleeding does not occur before the third stage, because the placenta is not then separated.

Bleeding during the third stage is slight, because the retraction of the uterus greatly occludes the vessels of the placental site before separation of the placenta commences.

Bleeding after the third stage is prevented by contraction of the torn vessels, by compression of the vessels in the muscular wall, by pressure on the placental site by the opposite wall of the uterus, and by thrombosis.

We omit the discussion of unduly early separation and expulsion of the placenta, as it must be explained according to the above principles, and with due regard to the circumstances of each particular case.

CHAPTER XIV.

MANAGEMENT OF NORMAL LABOUR.

Duties of Accoucheur.

When engaged during pregnancy, the practitioner should attend to the hygiene of pregnancy; and if the patient is a primipara he should endeavour to form some idea as to what sort of labour is likely to result. Thus he should make himself acquainted with the state of the circulatory system, and should not neglect to test the urine for albumen occasionally during the later months. It is even more important to ascertain that the bony pelvis is of normal dimensions. Very frequently some marked contraction of the pelvis is discovered only when labour is far advanced, a circumstance no less unfortunate for the practitioner than for mother and child. Therefore, if the patient is not obviously well grown and of good pelvic conformation, the practitioner should request to be allowed to measure the external diameters of the pelvis. Very few primiparae will refuse this. If the intercristal diameter is not 1 inch larger than the interspinous, or if the external conjugate is less than $7\frac{1}{2}$ inches, a vaginal examination should be made in order to measure the diagonal conjugate. If the patient be a multipara her obstetric history will be enquired into.

Whether the practitioner has been previously engaged or not, he should attend at once when called to a lying-in woman. His services may be needed at once through delay in sending for him, through haemorrhage, or through

other accidents, which can be rectified if seen early, but not later. If false pains have occurred they must be diagnosed and treated by sedatives and aperients, and if labour is in an early stage, the patient can be left with greater security after having been seen. The duties of the accoucheur do not end till the patient is safely through the puerperium, but we defer the management of that period till the various classes of labours have been considered, and here take up merely normal labour.

Obstetrical Armamentarium.

Cleansing.—Soap and a nail-brush should be carried habitually as they are not always forthcoming. Turpentine is invaluable as a disinfectant and deodorant for the hands and instruments. Pure carbolic acid should be carried, with just enough water added to render it liquid. Crystals of permanganate of potassium are much more convenient than a solution. Perchloride of mercury or biniodide of mercury may be carried in the form of tabloids or in strong solutions. The mercurial solutions are the best for ordinary purposes, but as they tarnish metal instruments, carbolic acid must be ready for use when these are being employed.

Bladder.—A No. 10 gum elastic male catheter is better than a soft rubber catheter, as the latter may not be rigid enough to pass the head and enter the bladder. The short female catheter is not long enough to reach the bladder conveniently when the organ is drawn up above the pubes.

Rectum.—The practitioner may have to give an enema himself, when he must be careful not to use the same apparatus for this and for douching the vagina.

Douche.—The ordinary Higginson's syringe may be used for douching the vagina, or a portable douche can may be carried, or a simple syphon may be used. A very

good instrument consists of a long rubber tube with a weight at one end, to sink it to the bottom of a jug, a stiffened part to prevent kinking at the edge of the jug, and a syringe ball, by compressing which a few times the tube may be filled and syphon action started. The free end of the tube has a stopcock and nozzle, to which vaginal and intra-uterine tubes can be attached by short pieces of rubber tubing. Glass vaginal tubes are easily cleaned and are strong enough for use in the vagina. A tube for intra-uterine injection should also be carried: this should provide for free back-flow of the fluid. Glass ones often break, celloidin ones cannot be boiled, therefore metal ones are the best.

Lubricant.—Vaseline with carbolic acid $\frac{1}{20}$ does not corrode instruments, so is better than vaseline with corrosive sublimate. Carbolised glycerine jelly and other preparations may be used.

Instruments.—Scissors, curved needles, a needle holder, and some silkworm-gut or chronicised cat-gut, may be needed for repairing the perineum. A pair of forceps will be carried as a rule. A hypodermic syringe and a stethoscope should not be forgotten.

Drugs.—Chloroform should always be carried, and a small quantity of sulphuric ether. Many practitioners like to have with them chloral and some preparation of opium. Ergot is indispensable. It may be given by the mouth in the liquid extract; but it is preferable to have some form which can be administered hypodermically. Purified liquid extracts are sold for this purpose, as are tabloids of compressed ergotin. Simpson's formula gives an excellent fluid form, as the chloral has antiseptic and preservative actions.

℞.	Ergotin, .	ʒii.
	Chloral hydrate,	ʒss.
	Distilled water,	ʒvi.

m.

Dose—10 to 20 minims injected deep into the muscles of the buttock.

Bag.—The trouble of packing and unpacking a small bag is so great that it is best to have a large one. It should be long enough to hold a cranioclast when necessary.

Examination of the Patient.

The practitioner, by a few questions, must ascertain when the labour pains began, what is their severity, duration and frequency, and where they are located. He will enquire whether the membranes have ruptured or not, whether any "show" has been observed, and whether the bowels and bladder have been recently emptied. If he has not seen the patient before he will also ask some questions about previous confinements and the patient's general health.

The hands must be washed with hot water, soap and turpentine, and then soaked in a warm antiseptic lotion. Corrosive sublimate 1 in 1000 is not too strong for this purpose, but 1 in 2000 is strong enough for the further cleansings needed as labour proceeds. It is not a general custom to include the abdomen in the first examination of a parturient woman, but it should be done when possible. The practitioner should also glance at the breasts at a convenient time, in case the nipples need attention preparatory to lactation.

Abdomen.—Inspection informs as to undue distension, pendulous belly, or marked separation of the recti.

Auscultation gives the position, frequency and character of the foetal heart sounds, and assurance that the child is living. By palpation it is usually easy to recognise the foetal head, thus determining the presentation; and the back, thus almost determining the position. If these are found to be normal, vaginal examination is superfluous,

except to determine the state of the cervix and parturient canal. Measurement of the external diameters of the pelvis may give valuable information regarding any deformity that may be suspected.

Vaginal Examination.—It is usual to insert the examining fingers during a pain and to keep them in position until after the contraction has passed off. The condition of the passages is thus noted during contraction and relaxation of the uterus, the patient's attention also being distracted at the beginning of the observation. The os must first be found and its form and consistence noted, as well as the stage which dilatation has reached. The smooth surface of the membranes may be felt, or, if these have ruptured, the hairy scalp. The external hand should depress the fundus in order to bring the head within more easy reach. If the os internum has already disappeared, the cervical canal being dilated, and the head resting on the somewhat expanded os externum, the presenting part may be examined between pains, care being taken not to rupture the membranes. It is not necessary to go further than to make sure that the vertex presents. The fingers should next be run round the pelvis, noting any irregularity of form, and observing whether the rectum is empty or not. Just before completing the examination the tip of the middle finger should be applied to the sacral promontory, and if this is touched with unusual ease, a finger of the external hand should mark the position of the pubic arch on the index finger. A measurement of the diagonal conjugate is thus obtained, but it is difficult to do this accurately with the patient lying on her side; indeed, it is more satisfactory to keep her in the dorsal posture throughout the examination. The practitioner will note whether the vagina is normal in form and size, whether its walls are properly soft and relaxed, and whether there is a free secretion of lubricating mucus. The rigidity of the perineum and the size of the vulvar aperture will not escape observation.

When it is ascertained that the patient is pregnant and in labour, that the child is living and that the head is presenting, the patient and friends should be informed that all is right. The patient should not be told of any abnormality that may be discovered, but it should be mentioned to a responsible friend or relative. It is not wise to say when labour is likely to end.

The accoucheur should next see that preliminaries are properly ordered, considering the patient, the bed, and the lying-in room.

Preliminaries.

Patient.—A warm bath should be taken if possible at the beginning of labour, and in any case the external genitals should be carefully washed with soap and water, and then bathed with an antiseptic lotion. In most cases an enema should be given, as even if the rectum contains no faecal accumulation the washing of its walls will add to the perfection of the arrangements for asepsis. From half a pint to a pint of warm soap and water should be used, with the addition of two tablespoonfuls of olive oil, and if faeces are present in quantity a tablespoonful of castor oil or of glycerine.

The patient should wear a night-dress, which should be well tucked up all round and fastened with safety pins, or otherwise. Under this should be worn a skirt—not an old and dirty dress skirt to be thrown away afterwards, as this is a fertile source of sepsis; but a clean under garment recently washed. This can be removed after labour, and the night-dress lowered in its place. Stockings may also be worn to prevent chill.

Bed.—A narrow bed is much more convenient than a broad one. Feather beds should be avoided as they are not firm enough. If a wire spring mattress is used an excellent plan is to place a board underneath it during

labour and remove it afterwards. This gives a firm and level edge to the bed and also allows the patient to lie softly when her labour is over. The mattress should be protected by a piece of waterproof material, over which comes a blanket and two or three sheets, the extra ones to be pulled out one at a time during the puerperium, leaving a clean one below the patient without needless disturbance. Next comes a wide sheet of mackintosh, one side hanging over the edge of the bed, and on it a pad of folded sheet or blanket, these to be removed at the end of labour. Specially made pads of wood-wool are convenient, antiseptic, and absorb a large quantity of discharges. The upper bed-clothes should be safety-pinned or stitched together and fastened well back out of the way both for cleanliness and for the convenience of the attendants.

Room.—The lying-in room should be quiet, well ventilated, and as large as possible. In small houses the best room in the house should be temporarily adapted to this purpose. No room from which a bath-room or water-closet opens should be chosen, and there should be no sink or basin with waste-pipe passing from it. The room should be warm but not hot. There must be a plentiful supply of boiling water and of cold water at hand. Towels, diapers, a binder or bolster case, and tape or strong linen thread for tying the cord must not be forgotten.

Antiseptics.

The main risk in normal labour is that septic matter may be conveyed into the parturient canal. Two facts must be remembered, namely, that many women still die of puerperal septicaemia, and that many practitioners still completely neglect precautions for securing asepsis in their midwifery practice. There is a relation between these two facts, and the first duty of the accoucheur is to protect the patient from the possibility of septic infection. For this

purpose it is not necessary to apply any antiseptic substances to the interior of the genital canal. No douching of the vagina should therefore be done without some special indication. In the first and second stages douching washes away the useful lubricating secretion of the passages.

It is necessary, however, to guard against the introduction of septic matter by the fingers or instruments. The practitioner should therefore lay down rules for cleanliness for the nurse, and should adhere to them strictly himself. The hands should be rendered aseptic every time the patient's genitals are touched. The external genitals should be washed before and after every examination or the use of any instrument. Every instrument should be sterilised by boiling or soaking in an efficient antiseptic before use. Without a clean vessel, a clean instrument, clean boiled water, clean hands, clean external genitals, and a clean receptacle for the return flow, no douche should be given, as otherwise it is more likely to introduce than to remove septic matter. If the catheter is needed, the nurse must expose the external genitals and wash them carefully, she may then pass the catheter aided by vision. The practitioner may do this unaided by vision if the nurse has washed the parts. In the absence of a nurse the practitioner must himself expose the parts and cleanse them, aided by vision, and then pass the instrument, guiding it past the foetal head with a finger in the vagina.

Management of the First Stage.

Having given all necessary directions, the accoucheur may consider the propriety of leaving the house, having regard to the strength and regularity of the pains, the moistness and softness of the vagina, and the condition of the os. The rate of progress may be estimated by a second examination half an hour or so after the first. If the os is not larger than a half-crown in multiparae, or a crown piece

in primiparae, the patient may be left for a time. The practitioner should be sent for if the membranes rupture or if the character of the pains changes, as at the beginning of the second stage errors may be rectified in a way which is impossible later.

When in the house during the first stage, the practitioner should avoid staying long at a time in the patient's room, and should encourage her to walk about, sit, or lie on her back, not attempting to remain in one position. Any nutriment taken should be very light. The rectum and bladder must be kept empty. In a slow first stage, when the patient is weary and restless, twenty grains of chloral may be useful. Opium also has a good effect during dilatation. If the patient is really exhausted and the pains are few, weak and irregular, it may be well to give a dose of morphia, sufficient to secure several hours of sleep for the patient, after which the labour will continue with increased rapidity. The patient may be encouraged to cry out during the pains and must be prevented from straining down. Pressure upon the sacrum by the attendant relieves the pain in that region. Nausea and vomiting should be palliated. Stimulants should be carefully avoided. The membranes should not be ruptured before dilatation is complete, that is to say, till the second stage of labour, as the risks begin after the escape of the waters, which also form a better dilator than the unprotected head.

Management of the Second Stage.

The commencement of the second stage is discovered by noting the changed character of the pains, and by complete dilatation of the cervix on vaginal examination. Artificial rupture of the membranes now often hastens expulsion. This is done by pressing on the tense bag of waters with the finger, or with a sound, or any clean, pointed instrument. A vessel should be used to collect the escaping liquor amnii.

Posture.—The posture usual in this country during delivery is the left lateral. The dorsal position has some advantages under some circumstances, and is commonly used in America and on the continent of Europe. Ploss enumerates eight postures assumed during labour amongst various races—namely lying, leaning back, sitting, squatting, standing, kneeling, hanging, and swinging. The squatting gives an advantage at the outlet of the bony pelvis (see page 200), but it puts the perineal structures on the stretch, though it is favourable for the exercise of the accessory powers. Kneeling on the floor, the elbows supported on a chair, is an attitude popular amongst the lower classes in many parts of the country. It has the advantage of allowing the woman, after labour is over, to get into an unsoiled bed. Numerous stools, chairs, and other more or less uncomfortable contrivances have been constructed in the past; for example, the chair of Deventer, which every married woman in Holland was at one time supposed to possess. The midwife was often the possessor of a chair which was carried about from case to case. Professor A. R. Simpson has recently exhibited and described a delivery pan which is in use at the present time in Spain, and which is sold at the china shops. It is of glazed earthenware, like a pail in shape and size, with a flange or brim round the margin, on which the patient sits. A hole is cut out of the edge of the pan, 5 inches by 6 in size, through which the attendant can examine the parts and direct the child. The waters, blood and secundines are caught in the pail. This is a cleanly and simple contrivance, and doubtless very useful for women who can sit up throughout labour.

When the patient is lying on her left side, some firm object may be placed near her feet for her to press against, and a towel may be fixed somewhere within reach of her hands for her to pull upon during expulsive efforts. She should hold her breath and make voluntary use of the accessory powers, not crying out until each effort is over.

The position should be accurately diagnosed, and remembering the mechanism of labour, errors should be rectified. Thus in occipito-posterior positions flexion should be encouraged in order to secure the occurrence of long rotation of the occiput to the front. This is done by pressing the sinciput upwards, and is the sufficient and correct treatment. The sinciput may be pressed backward or the occiput forward, but this is unnecessary, as the pelvic floor will perform the rotation if the occiput is brought down upon it. If the position is good there is no need for further examination, but the practitioner should visit the lying-in room frequently, or stay in it in order to encourage the patient. He may occupy himself by giving her a little chloroform. Pressure on the sacrum during the pains is very grateful to the patient. If the pains are infrequent they can be brought on by kneading the uterus through the abdominal wall, and this may be done at regular intervals.

Preservation of the Perineum.—In primiparae this is a very important duty. If the perineum does not soften and relax early, time should be allowed for this to occur by doing nothing to hasten labour, and perhaps by the use of chloroform. Hot fomentation and greasy applications will do something towards softening the structures round the vulva. When the head is actually passing the perineum the parts should be exposed and watched, while two points are carefully remembered. 1. The head must not be allowed to escape too rapidly. 2. The head must pass the vulvar outlet with its smallest plane parallel to the plane of the outlet ; in other words, **flexion** must be **preserved** and **extension prevented**—the occiput must continue to lead, To secure the perineum, therefore, the operator should control the movement of the head with his right hand, the fingers being placed on that part which is already exposed, and avoiding direct pressure on the thinned and stretched tissues. The head can thus be pressed against

the pubic symphysis, and **flexion maintained**, while too rapid advance is checked. The thumb may be placed in the dilated anus, and may press upon the sinciput through the anterior rectal wall. The left hand may aid by pressure on the tissues behind the anus. The head may also be squeezed out between two pains by fingers or a thumb placed in the rectum, a good and safe method under some circumstances. It is also important to remember that flexion of the legs at the hips tightens the skin all over the buttocks and the back of the thighs. Therefore, when there is any tightness of the skin round the vulvar aperture, it can be greatly reduced by extending the legs at the hips and keeping them in a straight line with the body, for the skin thus set free from the buttocks slackens the tension round the vulva to a great extent.[1] To save the perineum, then, the left leg should be straight down the bed, the right leg should also be straight, and should be held up by the nurse.

As soon as the head is expelled, if the cord is round the neck it should be slipped over the head. Failing this, it should be pushed up over one of the shoulders; and if this cannot be done it should be tied in two places and divided between the ligatures, as a shortened cord may prevent birth and asphyxiate the child. The eyes should next be wiped clean. The birth of the shoulders should not be hurried. The child's face becomes congested during pains naturally; if it remain congested between the pains, then birth must be hastened. This is done by squeezing the child out by pressure on the uterus through the abdominal wall. When a finger can be passed into one axilla, traction may be used, the fundus being depressed and made to follow the advancing breech. This is done with the left hand, which should rub and knead the uterus to encourage good contraction and retraction, and so prevent undue bleeding when the placenta is separated. At this time it

[1] Author, Edin. Med. Journal, July 1895.

should be made certain that there is not a second child in the uterus.

Ligature of the Cord. — If the cord be tied and cut before pulsation in it has stopped, about three ounces more blood escapes from the placental end than if it is not tied and cut till pulsation has ceased (Budin). So that tying the cord at once robs the child of a large quantity of blood. If the cord be not cut till pulsation has ceased, the child's skin turns yellow in a day or two and remains so for a few days. This is not due to jaundice, but to the breaking down of some blood corpuscles. The child, however, does not lose weight during the first few days, like those in which the cord is tied early. Pulsation in the cord usually ceases in 4 or 5 minutes, but may continue 15 or 20 minutes. A good rule, therefore, is to wait 5 minutes before tying the cord, unless the mother happens to be bleeding in a manner which cannot be checked by external manipulation of the uterus. If the child does not cry freely it can be slapped or sprinkled with cold water, and even artificial respiration can be performed by Dr Buist's method (Chap. xix.) before the cord is cut. If bleeding from the uterus requires active attention the cord must be severed at once and the child taken out of the way. The ligature should be tied $1\frac{1}{2}$ in. from the umbilicus and should be tightened up gradually till it cuts through or compresses the Wharton's jelly and effectually closes the vessels. Several strands of linen thread make a good ligature, tape does equally well, elastic ligatures are quite unnecessary. The cord should be cut through $\frac{1}{2}$ in. beyond the ligature. It is needless to tie a second ligature unless there is a second child in the uterus.

It is next advisable to look carefully at the **perineum** to see if it is torn. If it must be repaired by stitches this can be done at once, while waiting for the placenta to separate (Chap. xviii., p. 366).

Management of the Third Stage.

This is perhaps the most difficult stage of normal labour as regards management. Various fashions have prevailed, varying between leaving the placenta *in situ* for hours, and attempting to squeeze it out almost immediately after the child. The custom of seizing the cord and by it pulling out the placenta has not yet entirely disappeared in spite of its well-known results—imperfect removal of the placenta, haemorrhage, and even inversion of the uterus.

The uterus usually is perfectly able to separate the placenta and expel it into the vagina, but, with the patient recumbent, it tends to lie there for an indefinite time. A common custom is to cause sneezing with a pinch of snuff, and the act of sneezing expels the placenta from the vagina in a perfectly physiological manner. Left quite alone, 44 per cent. of placentae were found to escape in the first hour, 25 per cent. in the second hour, 11 per cent. in the third hour, and so on. Thus some artificial way of removing the placenta from the vagina must be used, and it is not unusual to aid its expulsion from the uterus into the vagina. Crédé's well-known method of treating the third stage consists in keeping a hand on the uterus, grasping the fundus with the fingers and thumb, and manipulating it gently to promote contraction. After allowing a few minutes to elapse, the uterus is squeezed during contraction to promote expulsion, and when the placenta is felt to be expelled from the uterus, further depression of the uterus in the axis of the pelvis aids its expulsion from the vagina. This method has been very greatly abused in efforts to rapidly conclude the third stage, and hurried and excessive squeezing of the uterus has done much harm by causing portions of placenta and membranes to be left in the uterus. Hart, holding that no amount of retraction can separate the placenta, urges that the uterus should be allowed to relax freely during the third stage, unless there be haemorrhage, and

that supra-pubic pressure should only be used to promote expulsion.

The most satisfactory method is to make no pressure for fifteen or twenty minutes, but to knead and rub the uterus frequently if this is necessary to secure satisfactory contraction. The hand should be kept constantly on the fundus, lest undue relaxation and bleeding should occur. The passage of the placenta into the passive part of the canal is recognised by the reduced size of the fundus. If this does not occur naturally in twenty minutes, Crédé's method may be used, pressure being applied at intervals to see if the placenta can be expelled. When the placenta is lying in the vagina, it will slip out if the perineum be held back, or it can be hooked out with the fingers. It should now be turned round a few times, so as to twist the membranes into a rope; but if they do not come away easily, a finger should be passed up the rope, tracing the membranes to their point of attachment and freeing them gently from below upwards. Unwise twisting of the membranes may break them through, so leaving a portion of them in the uterus, or even causing the existence of a succinturiate placental mass to be overlooked. The left lateral position is convenient for the third stage, but with the patient on her back, the hand has much more complete control over the fundus. If the placenta cannot be expelled from the uterus in about an hour after the birth of the child, it must be considered to be adherent, and a hand must be inserted into the uterus to separate and remove it. There is one circumstance under which this must be done without waiting. For if there is haemorrhage going on which cannot be checked by compression of the uterus, the organ must be emptied at once, and if the Crédé method fails to accomplish this, the placenta must be removed by a hand in the uterus.

Ergot should not be given until the third stage is over, as it often causes firm contraction of the whole uterus which

closes the retraction ring upon the placenta and prevents its escape. Ergot is perhaps the most frequent cause of retention of the placenta in the uterus. Neither should ergot be given after labour, unless there is bleeding, or marked relaxation of the uterus. For the general principle of treatment should be observed that unnecessary medication is to be avoided. If ergot is needed it may be given by the mouth, or a pure fluid preparation may be injected deeply into the muscle of the buttock (see page 258). It is not for normal labour, but in case of complications, that Ergot should be carried in the obstetric bag.

Management after the Third Stage.

If there is bleeding which cannot be checked by suprapubic compression, a very hot douche should be given. 120° F. is the maximum temperature for this purpose, but it should not be lower than 115° F. (see post-partum haemorrhage). Ergot may now be given as above. If there is no bleeding the uterus must be palpated frequently during the next half hour to see that retraction is good. The placenta and membranes must be examined to see that no portion of either has been left in utero. They should be placed in water, and the uterine surface of the placenta should be inspected, making sure that all the lobes fit in with one another and are complete. The membranes should be large enough to cover the foetus, and should form a complete sac except at the point of rupture. The chorion is the less tough, its uterine surface is roughened by the decidua which adheres to it, and it is attached to the margin of the placenta. The amnion is the tougher membrane and runs on to the foetal surface of the placenta, from which, as from the chorion, it can easily be torn. A hole in the chorion suggests that a succinturiate placental lobe has been left. Any deficiency in placenta or membranes demands an examination of the

uterus, but portions of the chorion are often left in utero and come away later with the lochia.

It has recently been the fashion to douche the vagina after labour, but this is now becoming less common. A douche given without complete aseptic precautions is a source of danger. A warm douche encourages haemorrhage, and washes away the clots from the ends of torn vessels in the placental site, while a douche hot enough to check haemorrhage is uncomfortably hot to the patient. If no septic matter has been introduced during labour there is no object in douching, so, on the whole, it is better to omit the process unless there has been an undue amount of examination or instrumental or manual interference.

In hospital and dispensary practice it is usual to drop a little solution (1 in 2000) of corrosive sublimate into the eyes of the child as a preventive against possible ophthalmia neonatorum. This should be done when there is any probability of gonorrhoeal infection. Nitrate of silver ($\frac{1}{2}$ in 100) is often used for this purpose, but it causes a good deal of inflammation.

Half an hour or so after labour everything soiled should be removed from the patient and bed, and a warm clean diaper should be applied to the pudenda. The use of a binder gives some support and comfort, but is of no use as a preventive against haemorrhage. No pad should be used, as it only pushes the uterus to one side. The binder should be about 14 inches wide and should reach down to the great trochanters. It should be fastened with pins so as to fit tightly below, but quite loosely above.

Anaesthetics during Labour.

Whatever anaesthetic may be preferred for surgical purposes the safest and pleasantest during labour is chloroform, which is taken particularly well by pregnant and parturient women. It should not be administered as a rule

during the first stage, as this would involve its use during a prolonged period; but in some cases of cervical rigidity its effect in aiding dilatation far surpasses that of chloral or opium. In the second stage chloroform may be given whenever the patient asks for it, or when the practitioner thinks its use advisable for the relief of pain or to control the frequency and violence of the pains. It slows labour somewhat, but, as a rule, time thus lost may be regained by the judicious use of the forceps. In the hands of a skilful practitioner the patient will fare much better with both chloroform and forceps than without either, as pain, time and fatigue are saved. It is stated that chloroform increases the tendency to post-partum haemorrhage. Now it is well known that, as chloroform anaesthesia passes off, a vessel may begin to bleed which did not bleed while anaesthesia lasted. But it is impossible to prove that bleeding which occurs after chloroform is caused by the chloroform. It would indeed be absurd to refrain from the use of the anaesthetic in midwifery on this ground, and if the third stage be properly managed there is no trouble from haemorrhage after chloroform has been used.

For obstetric purposes only a partial degree of anaesthesia is needed. A little chloroform should be sprinkled on a towel or an inhaler, and inhaled, at first freely, by the patient. It is not necessary to abolish consciousness or even to completely destroy self-control. A few whiffs should be given during each pain until the head distends the perineum, when more complete anaesthesia may be produced and maintained till the head is expelled. In all obstetric operations the full physiological effect of the drug should be produced, as if self-control is destroyed without abolition of the reflexes, the patient's movements interfere greatly with all manipulations.

In giving chloroform to the surgical extent, it does not matter how much is poured out of the bottle, but everything depends on how much is inhaled by the patient.

This is judged by the effect on the patient alone. No attention need be paid to the pulse, but every respiration should be watched, as in case of an overdose the breathing will cease before the heart. When the conjunctival reflex disappears and muscular rigidity passes off, the administration should cease; but more should be given as soon as either reappears. Stertorous breathing also shows that administration should cease for a time. The pupils generally contract as anaesthesia deepens, to a certain point, after that they dilate again, which is a sign to stop. The pupils then contract again, and as anaesthesia begins to pass off, they again dilate. Patients are not all alike in this respect, but, in many cases, after a few minutes it will be found that a right degree of anaesthesia can be maintained by keeping the patient's pupils near the maximum degree of contraction. The circulation may be watched as a matter of interest, but not as a guide to the administration of chloroform. If it flag, a little ether may be inhaled with the chloroform. If it fail, hypodermics of ether, brandy, strychnia, digitalin or strophanthin may be used, and a hot sponge may be applied to the precordial region. If respiration ceases, artificial respiration must be performed, and the tongue should be pulled strongly forward.

Chloroform should never be administered except with the patient in the horizontal position, and free from all pressure from clothing. If the stomach is not empty, vomiting should be allowed to empty it; but if the stomach is empty, vomiting should be postponed, by pushing the chloroform, until the operation is completed.

Summary of Management of Normal Labour.

First Stage.

1. Examine as little as possible after making sure that the patient is pregnant and parturient, and discovering the presentation and state of dilatation.

2. Let the patient walk about during the first stage, and, when she lies down, do not attempt to keep her in one position.

3. Keep the bladder and rectum empty.

4. Allow none but the lightest nutriment and avoid stimulants.

5. Attend to ventilation and keep the patient cool.

6. Prevent expulsive efforts and encourage the patient to cry out during pains.

7. Attend to shivering, nausea, vomiting, restlessness, or despondency.

8. Do not rupture the membranes.

Second Stage.

1. Discover the position and avoid further examination.

2. Do not overlook prolapse of the cord.

3. Leave the labour to nature till the head is on the perineum.

4. Palliate unpleasant symptoms, relieve pain by pressure on sacrum. Encourage the patient to strain down, holding breath during the pains.

5. Have the limbs separated by the nurse or a pillow when the head reaches the outlet.

6. Guard the perineum by preventing too rapid escape of the head, and by promoting flexion and preventing extension.

7. Follow down the fundus, clear the mouth, and wipe the eyes.

8. See that the cord is not round the neck.

9. Do not hurry delivery of the body and guard the perineum as the shoulders pass.

10. Keep a hand on the uterus, and make sure that there is not a second child.

11. Do not tie the cord till the child has cried vigorously, till pulsation ceases in the cord, and till the uterus is firmly retracted.

Be sure to tie two ligatures and cut between them if a second child is in the uterus.

12. Stimulate the patient if necessary, and do not neglect the uterus.

Third Stage.

1. Examine the perineum and stitch it at once if necessary.

2. Rub and knead the uterus if it relaxes unduly.

3. Compress the uterus 20 minutes after the birth of the child, and at intervals till the placenta is separated.

4. When expelled into the vagina, remove the placenta, and twist the membranes into a cord, keeping a finger in the vagina.

5. If compression will not expel the placenta from the uterus after an hour, introduce a hand and remove it.

6. Hold the uterus for some minutes to ensure retraction.

7. Examine placenta and membranes, and if imperfect, search the uterus for the missing portions. Give a hot antiseptic douche if the hand has been inside the uterus.

After Delivery.

1. Remove all soiled articles.

2. Have the patient cleansed.

3. Apply a warm diaper and the binder—tight below, loose above.

4. Keep the patient horizontal and quiet.

5. Do not leave the house till an hour after the 2nd stage ends, occupy the time in attention to the child (umbilicus, eyes).

6. Call in about 12 hours; be sent for if fainting, rigor, pain or bleeding occurs. (See Puerperium and Hygiene of Infancy.)

CHAPTER XV.

MORBID LABOUR.

HAVING discussed normal parturition and its management, we now pass to the consideration of morbid or laborious parturition in cases where the head presents, and take up together the cases which terminate either as lingering or as instrumental labours. We repeat the classification of labours to remind the reader of the relation of the present chapter to the rest of the subject.

I. Natural { Normal. / Morbid { Lingering. / Instrumental. }
II. Praeternatural.
III. Complicated.

We placed the time limit to normal labour at twenty-four hours; but it must be remembered that many women are exhausted in a shorter time, while many can support the fatigue of labour for a much longer period without any serious result. The line between normal and morbid labour must therefore be drawn, in practice, according to the state of the patient, and not by the watch. It is also important to remember that if the first stage is prolonged, say to fourteen or sixteen hours, the second stage is also likely to be slow. In labours lasting over twenty-four hours the mortality is four times as great as in those ending in less than twenty-four hours. In labours lasting over thirty-six hours the mortality rises to twelve times its frequency in cases terminated in less than

thirty-six hours. The reasons of this are that delay causes exhaustion of the patient in general and of the uterus in particular. Haemorrhage and sepsis are thus favoured. Injury of the maternal structures is caused by prolonged pressure of the foetal head upon them, and may be followed by sloughing of parts (*e.g.*, vesico-vaginal fistula). Prolonged stretching and thinning of the lower segment favours rupture of the uterus. The life of the child is endangered by the liability of interference with the placental circulation.

Causes of Delay in the First Stage.

I. Faults in the Powers (*i.e.*, in uterine action).

These rarely cause delay, as the uterus is, as a rule, able to canalise the lower uterine segment and cervix when the other factors are normal.

II. Faults in the Passages.

1. **Rigidity of the Cervix.**—This may be **functional**, the structure of the cervix being altered by no pathological change. Two varieties of simple rigidity are described.

The first is the so-called *constitutional* rigidity of the cervix met with in elderly primiparae. The margin of the cervix is regular and circular but thin, dry and even membranous to the touch.

The second is the so-called *spasmodic* rigidity in which the cervical or sphincter muscles of the uterus fail to relax. The os is felt to become smaller instead of larger during the pains. This is usually associated with inefficient contraction of the body of the uterus (see page 191).

Rigidity of the cervix may also be **organic**, due to structural changes of a pathological nature.

Tears inflicted at previous labours result in the formation of cicatricial tissue which renders the cervix unduly fibrous and tough. Infective processes, due to the absorption of septic matter by the lacerated surfaces, render more serious

these *inflammatory thickenings*, which are diagnosed by the thickness, hardness and irregularity of the edge of the cervix.

New growths of a simple nature may impede dilatation, as, for instance, when fibro-myoma invades the cervix.

Malignant new growths (carcinoma cervicis) may render dilatation dangerous from haemorrhage, and may prevent it altogether. These are diagnosed by digital examination.

Rigidity	Functional	Constitutional.
		Spasmodic.
	Organic	Inflammatory.
		New growths (simple and malignant).

Treatment.—Warm baths are useful. Chloral may be given, 15 gr. to 20 gr. every three or four hours. Morphia is conveniently given as a $\frac{1}{4}$ grain suppository. Many prefer a freshly-made pill containing $\frac{1}{2}$ grain of opium. If it is necessary to procure several hours of rest, chloroform may be given, followed at once by a hypodermic injection of morphia. If the patient is not disturbed as anaesthesia passes off, she will sleep straight on, and awake much more fit to continue the efforts of labour. Hot douches are extremely useful. The injection of glycerine (℥i to ℥ii) into the lower-uterine-segment is very effective. A large Barnes bag placed in the vagina and distended keeps the glycerine from escaping, and itself stimulates uterine contraction. Chloroform is the best treatment for spasmodic rigidity. Artificial dilatation is much aided by anaesthesia. It may be produced by the fingers, which are swept round the lower segment separating the membranes from it, and then used to exert gentle pressure on the edges of the cervix. Barnes bags may also be used, or the conical inelastic bag of Champetier de Ribes. If the cervix must be incised, several incisions from $\frac{1}{2}$ to $\frac{3}{4}$ in. in length should be made at different parts of its circumference. This is only done as a preliminary just before artificial delivery.

2. **Occlusion of the Os Uteri.**—The lips may be simply

glued together or may be firmly united by cicatricial tissue. The cause is previous endocervicitis, often treated by escharotics early in pregnancy. Rupture of the uterus may follow if the condition is not treated. Diagnosis may be difficult, as the stretched tissues may be mistaken for the membranes. A speculum should be used, and the tissues should be scratched through, avoiding, if possible, rupture of the membranes.

3. **Malposition of the Uterus.**—In anteversion of the uterus through pendulous belly or separation of the recti, the force of the uterus may be so misdirected that dilatation is not produced. This is rectified by placing the patient on her back and applying a firm binder so as to keep the uterus in a proper position.

4. **Impaction of part of the Cervix** between the head and the pubes.—This is often found in cases of pendulous belly. The anterior lip becomes swelled and oedematous, and has been mistaken for the bladder, for the bag of waters, and for the caput succedaneum. During intervals between the pains the impacted part must be gradually pushed up bit by bit above the head. During the pains it must be supported to prevent its further descent.

III. Faults in the Passenger.

1. **Hydramnios.**—This is a common cause of delay in the first stage. The uterus is over-distended, so that it works at a disadvantage, and the head of the foetus does not engage in the pelvis (see page 153). It is treated by drawing off some of the liquor amnii. If possible, it is well to puncture the membranes high up, so as to leave the fore waters intact.

2. **Deficiency of Liquor Amnii.**—This may be found although the membranes are intact. The head should be pushed up so as to allow all the fluid that is present to descend past the head and form a bag of fore waters.

There may be no liquor amnii, or it may have escaped at an early rupture of the membranes due to their thinness, to careless examination, to errors of presentation, or to deformity of the pelvis. Such cases are known as "dry labours" and are apt to be very tedious, especially if pelvic deformity or largeness of the skull prevents the head from descending to replace the bag of waters as a dilator. The best treatment of dry labour is to replace the bag of waters by a partly filled de Ribes bag, and allow the uterine forces to complete dilatation and expel the bag into the vagina. Artificial dilatation by the fingers or Barnes bags may be necessary (see Induction of Labour). The diagnosis needs care, as the chorion only may be ruptured, leaving intact a bag of amnion.

3. **Adhesion of Membranes** to the lower-uterine-segment. —This prevents the formation of the bag of waters, and great toughness of the membranes may have the same effect. The treatment consists in separating the membranes by sweeping the fingers round the lower-segment.

Summary of Causes and Treatment of Delay in First Stage.

I. Faults in Powers.	Rare.
II. Faults in Passages.	1. Rigidity of Cervix (functional, organic).
	2. Occlusion of os.
	3. Malposition of Uterus.
	4. Impaction of Cervix.
III. Faults in Passenger.	1. Hydramnios.
	2. Deficiency of Liquor Amnii (dry labour).
	3. Adhesion of Membranes.

There are three great lines of treatment. The first is practically postponing labour and allowing a period of rest, after which the patient may be able to manage dilatation herself. This is done by sedatives.

The second consists in aiding natural dilatation. This

is done by warm baths and douches, by posturing and binders, by glycerine and lubricants, and by bags placed in the passages, distended, and left *in situ* for the uterus to work upon.

The third is artificial dilatation by the fingers, or by Barnes bags introduced and distended one after another. If the bag of Champetier de Ribes is used the operator pulls on its stalk. The essential difference between natural and artificial dilatation is that in one the force is supplied by the uterus, while in the other it is provided by the operator. The formation of a retraction ring which can be felt above the pubes is a signal to commence artificial dilatation. Prolonged pressure of the head on the soft parts must also be prevented, and the patient must not be allowed to become exhausted. The membranes should be preserved intact as long as possible except in hydramnios.

Causes of Delay in the Second Stage.

I. **Faults in the Powers** (Uterus and Accessory Powers).

1. **Inefficiency of the accessory powers.**—Paralysis and paraplegia of various muscles may prevent or impair their action in raising intra-abdominal pressure. In heart disease it is dangerous for the patient to fully employ the accessory powers, and she must be prevented from doing so. In phthisis the same caution must be observed, as emphysema may follow voluntary expulsive efforts. Thus the tissues at the root of the neck may sometimes be seen to swell from subcutaneous emphysema when the patient holds her breath and strains violently. Ascites, a loaded rectum, or a distended bladder may impede the action of the powers, as may general exhaustion of the patient from a prolonged first stage. In the absence of the lower limbs it has been noted that inability to fix the pelvis has delayed expulsion. The treatment as a rule is the application of forceps.

2. **Inefficiency of the Uterus.**

(*a*). **Atony or inertia** of the uterus is often seen in elderly primiparae, in cases where the uterus is worn out by previous pregnancies in rapid succession, and where previous children have not been nursed. It is also caused by exhaustion of the organ during a prolonged first stage, by fibroid disease, by over-distension due to twins or hydramnios, or by sudden removal of a portion of the uterine contents. Fright or other disturbance of the nervous system is a frequent cause of uterine inertia.

The treatment consists, in the first place, in encouraging uterine action. Changes of posture and the use of bandages may be useful. Rubbing and compression through the abdominal wall are invaluable. Foreign bodies in the vagina (such as the fingers or india-rubber bags) stimulate contraction, as do hot douches, and chemical irritants such as glycerine. Rectal applications of glycerine and other enemata may be used. Oxytocic drugs such as Ergot should be avoided. If encouragement is not sufficient, assistance must be given to the powers by firm pressure at intervals over the fundus. When the second stage has lasted $3\frac{1}{2}$ hours in primiparae or $2\frac{1}{2}$ in multiparae the forceps may be used.

(*b*). **Partial or Spasmodic Uterine contraction.**—This is a condition similar to those seen before labour in some kinds of false pains, during the first stage in spasmodic rigidity, and during the third stage in the so-called hour-glass contraction. In the second stage it is due to exhaustion, to too frequent examination, to early rupture of the membranes, to distension of the bladder or rectum, or to disease of the uterine wall. The contractions are very painful, but ineffective. The pain is localised. If the membranes are unruptured a sedative may be given; or, better, chloroform anaesthesia. If the membranes are ruptured, forceps should be applied under chloroform, after emptying the bladder and rectum.

II. Faults in the Passages.

1. **Narrow or rigid Vagina, Vulva or Perineum.**—These are found in elderly primiparae and in strong muscular women. Some are cases of congenital narrowness, others are due to cicatricial contraction after previous pressure injuries. The perineum may extend farther forward than usual, the hymen may be more tough and resiliant than usual, and the pressure of the head on parts of the canal above may cause undue congestion of the structures at the outlet. Some cicatricial contractions soften and relax wonderfully as labour progresses, but, like congenital malformations, they may demand incisions. These should always be made during a pain, and never until all aids to relaxation have been tried, such as hot douches, glycerine, emollients, and warm sponges. Compression from above should aid the expulsive powers. Examinations should be as few as possible.

If it is obvious that the head cannot escape without tearing the perineum, episiotomy must be done. For it is preferable to make two clean cuts into the lateral margins of the vulvar outlet, than to have a tear extending centrally into the perineal body and possibly involving the anus. The lateral incisions are made with a pair of scissors, they should be sufficiently far back to avoid injury to the ducts of the glands of Bartholin. They can often be confined to the vaginal mucosa, the skin not being cut at all. As soon as delivery is over, these incisions should be stitched up with catgut. They heal quickly with an almost invisible scar, and leave the patient absolutely uninjured, which is far from the case in many tears of the perineum (see Complications of Labour, p. 365).

2. **Distended Rectum or Colon.**—Faecal accumulations not only interfere with the powers but may obstruct the passages. They must be removed by copious enemata, by washing out the rectum (see page 129) or by the use of a scoop under chloroform.

3. **Enterocele.**—Hernia of the intestines into the pouch of Douglas is a rare impediment and is diagnosed by recto-vaginal examination. The patient should be placed in the genu-pectoral posture and an attempt made to push up the displaced intestines. If this fail the forceps should be used without delay, as slight pressure for a long period is much more likely to injure the coils of intestine than severe pressure for a short time.

4. **Bladder. Distension.**—The distended bladder may be seen and felt as a rounded fluctuating tumour above the pubes. It should be emptied by the catheter (see page 263). If this is impossible the bladder must be aspirated above the pubes. Prolapse of the bladder or **Cystocele** may occur, and the organ may be mistaken for an impacted part of the cervix, for the bag of waters, for the caput succedaneum, or for various tumours. The catheter should be used to confirm the diagnosis and to empty the organ, which should then be pushed up. Stone in the bladder, or **Vesical Calculus**, is a rare complication, recognised, during pregnancy or labour, by vaginal examination or by the sound or catheter. If found early during labour the stone should be pushed above the brim. Later it may be removed through the dilated urethra, but if this is impossible it must be removed by an incision into the bladder through the middle line of the anterior vaginal wall. When labour is over, the incision should be closed immediately by a series of sutures. If this is done complete union is easily secured, and no vesico-vaginal fistula need result. Labour cannot go on safely with the stone in the bladder and below the brim, therefore the operation for removal should be done during pregnancy if the presence of the calculus is ascertained.

5. **Ovarian and Parovarian Tumours.**—These, if large, are usually abdominal and interfere with the accessory powers. If they are small — *e.g.*, dermoid cysts and solid ovarian tumours — they may be pelvic and may

obstruct the passages. The abdominal tumours usually allow of successful termination of the labour by forceps. The pelvic tumours often cause a fatal result through rupture of the uterus, vagina or rectum; through simple or malignant peritonitis following rupture of the tumour; or through operative interference under great difficulties. In the genu-pectoral posture it may be possible to push the tumour above the pelvic brim, causing it to pass on one side or other of the promontory. If this cannot be done delivery must be attempted by forceps. The tumour may be incised if necessary, and its contents evacuated. If these measures fail, the case must end in a cutting operation or in embryulcia. The diagnosis demands very careful examination. If it is made during pregnancy, premature labour may be induced, or the tumour may be removed by abdominal section.

6. **Other Tumours of Soft Parts.**—Fibroid tumours of the uterus are apt to produce malpresentation and to cause impaired and irregular uterine contraction. They may be situated so as to cause obstruction in the second stage. Polypi and cysts of the cervix may occupy the vagina and obstruct the passages. Abscess or solid inflammatory deposits in various positions may form obstructions, as may masses of malignant new growth. Haematoma may form during labour through laceration of venous structures in any part of the vaginal walls. The effused blood may form a localised swelling or may infiltrate under the vaginal mucosa, under the skin of the perineum or under the peritoneum. It may pass upward over the pelvic brim and extend as high as the kidney. The vulva may be the site of various tumours, of blood effusions, inflammatory deposits, varicose veins, and oedema. All these conditions may offer more or less obstruction to the passage of the foetus. Their treatment varies, but the general principles are to aim at relaxation of the structures and removal of the obstruction by compression and change of the position

of the tumour. Those containing fluid may be evacuated if necessary, but recently formed blood effusions must not be opened before coagulation is complete, for fear of haemorrhage.

Solid removable tumours may be extirpated at once. The operator must be prepared to deliver rapidly by forceps or turning after interference. A cutting operation or embryulcia may be necessary.

7. **Abnormal Pelvis.** — Contractions of the various diameters of the bony pelvis are amongst the most serious causes of delay in labour, and are those which usually call for operative interference.

During pregnancy the head is prevented from sinking into the pelvis; deviation of the axis of the uterus forward or to one side or the other results, and the abdomen is unduly prominent. During labour the head may not fit into the dilating passages, so that communication remains between the fore and the hind waters. Sausage-shaped protrusion of the bag of membranes results, and, frequently, early rupture and total loss of the liquor amnii. The head being unable to descend and replace the bag of waters as a dilator, dilatation may cease, and the pains which continue to occur may only have the effect of stretching and thinning the lower-segment. The foetus may be expelled, its head distorted by exaggerated moulding and sometimes by fractures of the bones of the skull. If the contraction is great the progress of labour is indefinitely delayed, and ends either in complete exhaustion or in rupture of the uterus.

Risks to the mother are therefore all those attending on delayed labour; rupture of the uterus, bruising of the soft parts, sloughing from prolonged pressure of the head, and the dangers of operative interference. Malpositions and malpresentations are much more frequent in contracted than in normal pelvis. This increases the risk to mother and child, the latter of whom also has special risks from

undue pressure on the head, from tendency to prolapse of the cord, from delay and from interference on behalf of the mother.

Causes of Pelvic Contraction.

The human pelvis differs from those of lower mammals in certain features which are due to the assumption by man of the erect posture.

The spine of the foetus or young infant has only one curve and is concave forward. The cervical and lumbar curves, which are concave backward, gradually appear, leaving the original curve (concave forward) in the dorsal and sacral regions. The pelvis of the infant has a relatively long conjugate and narrow transverse at the brim, while its outlet is narrow, the cavity being funnel-shaped. It is not asserted that the shape of the pelvis is modified by mechanical forces afresh in each healthy infant, as it learns to sit up and then to walk. For if a person could be kept in health in the recumbent posture from birth to maturity, there is no reason to believe that the pelvis would retain the infantile type. What is stated is, that during the evolution of the human animal the shape of the human pelvis has been modified by mechanical forces rearranged as the erect posture was gained, that these forces still act and produce deformity when, for any reason, their normal action is exaggerated.

The weight of the body is a force acting directly downward from the centre of gravity in a line which normally passes through the promontory of the sacrum. This downward force is transmitted by the sacrum to the pelvis and by the pelvis to the ground. The resistance acts directly upward at the acetabula in standing or walking, and at the ischial tuberosities in sitting. The downward force may be considered as two components, one of them acting in the plane of the brim. This component tends to compress the brim in the conjugate and widen it transversely.

The proportion of the body-weight acting in the plane of the brim depends on the angle that plane makes with the horizon. Therefore the greater the inclination of the brim the greater is the force pressing the promontory towards the pubes. Thus increased pelvic inclination tends to shorten the conjugate, while decreased pelvic inclination tends to lengthen the conjugate relatively to the transverse.

The upward pressure upon the acetabula forces the sides of the pelvis inward and tends to narrow it transversely. Lines drawn directly upward from the ischial tuberosities normally pass outside the sacro-iliac joints, so that sitting tends to widen the outlet. If lines drawn upward from one or both tuberosities pass inside the sacro-iliac joints the result is the reverse, and sitting will tend to approximate the tuberosities.

The relations of these forces to the bones of the pelvis are altered by some errors of development and by certain diseases. Exaggerations of the normal effect of the forces then appear, and are seen in most varieties of contracted pelvis. Some deformities, however, can not be explained by mechanics any more than can the differences between the male and female pelvis, and depend upon the growth-type of different organisms. We now mention the most important causes which of themselves produce abnormal pelvis or which allow the mechanical forces in action to do so.

Individual Peculiarities. — Slight departures from the average size and shape of the pelvis may be characteristic of races, of families, or merely of individuals. They are to be explained as slight peculiarities of development accentuated, perhaps, by mode of life and employment. They account for variations in the size of the pelvis as a whole, and for variations in the proportion between its measurements. Thus we have the large pelvis or *aequabiliter justo major;* the small pelvis or *aequabiliter justo minor;* the *masculine* pelvis funnel-shaped like that of a male, with narrow pubic arch and transverse diameters.

Arrest and Errors of Development.—Arrest of development from various causes gives us the *infantile* pelvis resembling that of the foetus in shape, with long conjugate, narrow transverse and small outlet; non-development of one wing of the sacrum and anchylosis of the corresponding sacro-iliac joint gives the obliquely contracted pelvis of *Naegele;* a similar condition on both sides of the sacrum gives the transversely contracted pelvis of *Robert.* Again, undue projection of the sacrum gives a contracted conjugate or *simple flat* pelvis in cases where there is no evidence whatever of disease. Another condition, sometimes apparently congenital, is dislocation of the last lumbar from the first sacral vertebra with displacement downwards (Spondylolisthesis).

An extra sacral vertebra is occasionally present, and two vertebrae instead of one may enter into the formation of the promontory. In either case the available conjugate is likely to be lessened.

Imperfect development of the pelvis connected with congenital defect or absence of the organs of reproduction often comes under the notice of the gynaecologist, but is rarely met with in practical obstetrics, because pregnancy is usually prevented by the nature of the condition.

Congenital dislocation of one or both hips also modifies the form of the pelvis. Shortness of one leg tilts the pelvis toward the short side and overweights the short leg, with the result that the acetabulum on its own side is pushed inward.

Ossification of the sacro-coccygeal articulation causes lessening of the antero-posterior diameter of the outlet. It may occur before the end of reproductive life, but the joint usually remains movable till after the menopause. The anchylosis is usually broken down during labour without special difficulty and with no serious result. If the loose portion of bone gives inconvenience later it may be removed by a simple operation.

Rickets.—This disease of childhood usually develops during the first and second years of life. A morbid process which either is rachitis or closely resembles it may occur during intra-uterine life. Insanitary conditions and ill feeding cause the disease, which occurs mainly amongst the lower classes in large manufacturing towns. The leading feature of the disease is that the growth of the cartilaginous elements from which the bones are developed, goes on without the deposition of the mineral elements which should give hardness and rigidity to osseous tissue. Irregular and imperfect growth of the bones accounts for some changes in their shape; other alterations are due to the softness of the bones or parts of them, which allows them to be bent and distorted by the mechanical forces to which they are exposed. The long bones are thickened at the extremities, the flat bones are also thickened. The legs bend, as does the spine, the sternum is thrown forward, the ends of the ribs are thickened into beads. The wrists, ankles and knees are swelled. The anterior fontanelle remains open, and dentition is delayed.

This disease, according as it occurs earlier or later in childhood, and with greater or less severity, may cause all the pelvic deformities logically possible. Thus, by retarding development, it may give us a *rachitic generally contracted* pelvis, small in all diameters, or a *rachitic infantile* pelvis with transverse narrow relatively to the conjugate. By causing lateral curvature of the spine (scoliosis) it may throw the weight of the body to one side, whereby one acetabulum is pressed inward, causing a *scolio-rachitic* obliquely contracted pelvis. Most important amongst the results of rickets, however, is the relative shortening of the conjugate in the *rachitic flat* pelvis. The weight of the body pushes the sacrum downwards and forwards, approximating the promontory to the pubes. If the sacrum is not softened, it is depressed as a whole (elliptic flat pelvis); if it is much softened it is bent as well as depressed, the

promontory projecting towards the symphysis (kidney-shaped brim). The pubic symphysis may also be bent by muscular action backward toward the promontory (figure of 8 brim). These changes occur when, the disease being early and fairly severe, the child is usually in the sitting posture. The body weight is transmitted to the ischia which are everted by the counter pressure of the ground. If, however, the disease softens the bones at a later date when the child is running about, the weight of the body is transmitted to the legs, the counter pressure being at the acetabula instead of at the ischial tuberosities. In this case the acetabula and ischia are forced inwards, the promontory at the same time being depressed, causing the *rachitic rostrate* or triradiate pelvis (pseudo-malacosteon). All combinations of these alterations occur in pelves which may approach full size, but are usually small from impeded development. The varieties of pelvic deformity caused by rickets are thus very numerous.

Osteo-malacia (mollities ossium).—This disease, attributed to ill feeding and to certain climatic influences, is extremely rare except in certain districts where it is endemic. Like rickets, it softens the bones, not, however, by preventing deposition of mineral matter in them during their development, but by removing calcareous salts from them later in life, after they have been hard and firm for years. A disease of the female sex, osteo-malacia is typically seen in the half-starved woman with a large family who works hard for her living, exposed to cold and wet, suckling one child and heavy with another. Progressive as a rule, and recurrent in successive pregnancies, its course may be arrested, the bones becoming firm again but retaining the deformities impressed upon them while soft. Removal of the ovaries checks the course of this disease, which is marked by severe rheumatic pains, and distortion of the limbs. Crushing of the pelvis by weight of the body and counter-pressure at

the acetabula gives the triradiate, rostrate or true malacosteon pelvis.

Tuberculosis.—One leg may be rendered more or less useless by tubercular disease in the hip or other joint. The weight of the body being supported habitually by the sound leg, inpushing of the sound side of the pelvis will cause oblique contraction. Destruction of the sacro-lumbar joint and of parts of the lumbar vertebrae is doubtless one cause of the downward displacement of those vertebrae with narrowing of the conjugate (spondylolisthesis). The important result of spinal caries is, however, the production of the kyphotic pelvis. Destruction of the bodies of lumbar vertebrae causes the spine in that region to bend backward instead of having the normal lumbar curve forward. This kyphosis (curvature convex backward) in the lumbar region causes compensatory lordosis (curvature convex forward) in the dorsal region, so that both the normal spinal curves are reversed. The result on the pelvis is elongation of the conjugate relatively to the transverse, with narrowing of the outlet both laterally and antero-posteriorly.

Traumatism.—Accident may also affect the development of the pelvis in various ways. By shortening, dislocating, weakening or removing a leg, it may cause contraction of either oblique diameter. For a shortened but strong leg, being overweighted by lateral tilt of the pelvis, will indent its own side of the pelvis, while a healthy leg, overweighted by impairment of the function of the other, will also impress its own side of the pelvis. Injury may separate the body of the last lumbar vertebra from its arch, or may dislocate the whole vertebra, causing a traumatic form of spondylolisthesis.

Classification of Deformed Pelves.

Thus each of the causes may produce several varieties of deformity. We have discussed them together in order to

render less rambling the description of the types of contracted pelvis. The classification of deformed pelves is a difficult one. Below is a table, by no means complete, but simply arranged to show the relation of the various causes to the different deformities which are most important.

Cause.	Relatively narrowed. Conjugate.	Relatively narrowed. Oblique.	Relatively narrowed. Transverse.	All diameters. Lessened.
Developmental errors.	Simple flat. Double hip disloc. Split pelvis. Spondylolisthetic.	Naegele. Single hip disloc. Short leg.	Infantile. Robert.	Justo-minor.
Rickets.	Rickety-flat.	Scolio-rachitic.	...	Pseudo-malacosteon. Generally-contracted-rickety.
Tuberculosis.	Spondylolisthetic.	Hip joint disease.	Kyphotic.	...
Osteo-malacia.	...	...	...	Malacosteon.
Accident.	Spondylolisthetic.	Injury to one leg.	...	...

TYPES OF CONTRACTED PELVIS.

Uniformly enlarged Pelvis (*Aequabiliter justo major*).—An abnormally large but well formed pelvis is found in large framed, but not necessarily tall women. Precipitate labour may occur, but otherwise a large pelvis causes no inconvenience.

I. Generally Contracted Pelvis.

(*a*). **Uniformly contracted Pelvis** (*Aequabiliter justo minor*). —A well-formed pelvis simply smaller in size than normal is of rare occurrence. It is recognised by smallness in all the diameters, with the absence of undue projection of the promontory. Some specimens resemble the male pelvis; others resemble the infantile pelvis in form, being long in the conjugate; others are miniatures of the well formed female pelvis. These are all due to individual peculiarities, accentuated, perhaps, by mode of life.

(*b*). The **Generally contracted Rickety** pelvis occurs where development has been impaired by rachitis, and is usually distinguished by projection of the promontory, causing relative shortness of the conjugate. Slight rickety symptoms after the child is able to run about allow of slight sinking of the promontory under the weight of the body. Upward pressure on the acetabula by the legs prevents marked flattening. Growth of the bones to their full size is prevented by the disease.

Generally contracted Pelves are diagnosed by the appearance of the patient and by smallness of the external pelvic measurements. On vaginal examination the diagonal conjugate is short, and there is little room in the transverse.

The prognosis is worse than in flat pelves with the same conjugate, but more room in the transverse.

The **Mechanism** is marked by the presence of flexion from the beginning. For, as the head cannot enter the small brim with its occipito-frontal plane parallel to the brim, it substitutes the sub occipito-bregmatic diameter. Thus Roederer obliquity appears early, the occiput presenting instead of the vertex. Excess of flexion is the only peculiarity of the mechanism, and may first suggest the presence of the contraction.

Treatment.—In generally contracted pelves Version is

out of the question, as it allows extension of the aftercoming head, which is fatal to its passage through a pelvis with short transverse. Forceps extraction is successful with a conjugate down to about $3\frac{1}{4}$ inches. Below this symphyseotomy or embryulcia must be done, and in more marked cases abdominal section is necessary. The absence of room in the transverse renders the various operations necessary with larger conjugate diameters than is the case in other pelves. Induction of premature labour must be done rather earlier than in flat pelves of similar conjugate for the same reason.

II. Obliquely Contracted Pelvis.

(*a*). **Scoliotic.**—In lateral curvature of the spine the bodies of the vertebrae are rotated to one side, and the weight of

Fig. 39.—Scolio-Rachitic Pelvis. (Martin.)

the body is shifted to that side towards which the spine curves. An undue share of the body-weight is thrown upon the leg of the same side, and that side of the pelvis

is accordingly pressed inward. The cause is not invariably rickets, though it usually is so, and the commonest condition is a combination of flattening and oblique contraction (*Scolio-rachitic pelvis*). The pubic symphysis is pushed to the opposite side. The ischial tuberosity of the weighted side is everted by sitting. The oblique diameter shortened is, of course, the one measured from the weighted acetabulum to the opposite sacro-iliac joint.

(*b*). **Imperfect use of one leg.** — Absence, disease or injury of one leg throws undue weight on the other leg, and causes inpushing of the weighted side of the pelvis, *i.e.*, the side opposite the injured leg.

Congenital dislocation of one hip must be remembered in this connection.

(*c*). **Short leg.**—If a leg is short but strong, the pelvis is tilted downward on the side whose leg is short. This throws an extra share of body-weight on the short leg, which presses in its own side of the pelvis.

(*d*). **Naegele.**—In this pelvis there is absence of one wing of the sacrum and of the sacro-iliac joint, the ilium being anchylosed to the body of the sacrum. Typically caused by a developmental error—a similar condition may be produced by disease in infancy or childhood, causing sacro-iliac synostosis. The body-weight is thrown to the defective side, causing inpushing of that side of the pelvis, which exaggerates the deformity. The pubic symphysis is pushed to the opposite side. Absence of the sacral wing approximates the ischial tuberosity to the middle line so much that sitting causes its further inversion.

Obliquely contracted pelves are suggested by the spinal curvature, or by lameness, shortness or absence of one leg. The Naegele pelvis may be accompanied by no obvious deformity, but examination of the sacrum shows that one superior posterior spine is nearer the middle line than the other. The comparison of the external diagonal measurements of the pelvis gives further information, and

vaginal examination is still more important. The prognosis in those minor oblique contractions which occur with some flattening due to rickets is not serious; but in the major degrees of oblique contraction there is grave risk to mother and child.

Mechanism.—One corner or side of the pelvis is often quite unavailable. The head picks out the largest circle, so to speak, that can be drawn within the brim, and attempts to enter it, as in a generally contracted pelvis, in

FIG. 40.—Naegele Pelvis.

a flexed position. If flattening predominates over oblique contraction the head behaves as in a flat pelvis.

Treatment.—Version is out of the question, for the same reasons as in generally contracted pelves. Forceps often succeed. Symphysiotomy is said to be less valuable here than ischio-pubiotomy, performed by Pinard by sawing through the pubic and ischial bones of the affected side. Embryulcia is the alternative. Abdominal section may be necessary. Induction of premature labour or of abortion may be performed under the usual conditions.

III. Transversely Contracted Pelvis.

(*a*). **Kyphotic.**—In kyphosis (curvature concave forward) in the lumbar region, the inclination of the brim is decreased, the body-weight acts too far back, and the brim is drawn out antero-posteriorly instead of being compressed in that diameter.

In the false pelvis the ilia are straightened, the crests losing their arch and sinuous curve, and the anterior superior spines being thrown apart.

The true pelvis becomes funnel-shaped. The brim is altered by great increase of the conjugate, the transverse being relatively and sometimes absolutely diminished. The promontory is far back, and less depressed between the ilia than usual. In the cavity the conjugate is less increased than at the brim. The sacrum is narrowed laterally, elongated vertically and straightened. The outlet is not much altered antero-posteriorly, but its transverse, as a rule, is greatly contracted, the pubic arch being narrowed. This feature of obstetric importance Barbour finds to be sometimes absent.

The diagnosis is made easy by the hunchbacked condition of the patient. There is plenty of room at the brim, thus the main risks are severe laceration of the perineum and crushing of the foetal head at the outlet. Labour may end naturally after delay.

Mechanism.—The head does not enter the brim with its long axis in the conjugate as might be expected. The mechanism is only altered as the outlet is reached when excessive flexion occurs. The pubic arch is largely unavailable, so the head has to pass behind the ischial tuberosities, pressing strongly on the coccyx, which may be broken, and on the perineum. The head may be in the transverse till it reaches the pelvic floor, when the sinciput may come to the front in malrotation.

Treatment.—The forceps is usually successful. Embry-

ulcia may be necessary, as also the other operative measures under their usual conditions.

(*b*). **Robert.**—This pelvis shows the developmental error seen in the Naegele pelvis, but on both sides instead of on one. Both wings of the sacrum are absent, and both sacro-iliac joints anchylosed. The ilia are very straight and the brim is excessively narrowed. The tubera of the ischia are

FIG. 41.—Robert's Pelvis.

inverted and may be only two inches apart, the pubic arch being very narrow. The condition is very rare, and probably never allows of the birth of a living child. The available space is so small that embryulcia becomes a difficult and dangerous operation. Abdominal section and the early induction of abortion are the most favourable alternatives.

(*c*). **Infantile.**—In some cases the pelvis grows to its normal size, but remains long in the conjugate and funnel-shaped in the cavity. In labour the main difficulty is at the outlet, but is not likely to be so great as to cause failure in forceps extraction.

IV. Antero-Posterior Contractions.

(*a*). **Simple flatness** of the pelvis is said to occur as an individual peculiarity, the promontory projecting so as to somewhat lessen the conjugate of the brim, but no signs of rickety or other disease being present.

(*b*). **Congenital dislocation** of both hips causes some lordosis (curvature concave backward) and increase of the inclination of the brim. The body-weight then causes widening of the transverse and relative shortening of the conjugate. The pubic arch is wide and the ischial tuberosities far apart, the condition resembling slight rickety flattening.

(*c*). **Split pelvis** is caused by congenital absence of the pubic symphysis, the bones being connected by a fibrous band simply. A flat and wide pelvis results, but is seldom met with in obstetrics, pregnancy being prevented by accompanying defects in the reproductive organs.

Fig. 42.—Spondylolisthetic Pelvis. (Kilian.)

(*d*). **Spondylolisthesis.** — In this condition, which is ascribed to developmental error, to accident and to disease, part of the last lumbar vertebra projects into the true pelvis below the promontory. The body, transverse process and superior articular processes of the lumbar vertebra are displaced downwards, the laminae of its arch, the spinous process and the inferior articular processes are left in their usual position, according to Neugebaur's description. The posterior superior iliac spines are separated, as are the iliac crests. The outlet is narrowed

transversely and antero-posteriorly, the lower end of the sacrum being turned forward.

The diagnosis is easy. The deformity is often visible, as the buttocks project, the ilia approach the lower ribs, the iliac crests and the top of the sacrum are prominent. Vaginally the lumbar vertebra is felt and distinguished from the sacrum by the absence of wings. The narrow outlet distinguishes this condition from rickety pelvis. The prognosis is worse than in other flat pelves, because of the narrowness of the outlet. This also affects the treatment, as it renders version unsuitable. The conjugate must be measured to the lumbar vertebra, as the sacral promontory is actually farther than usual from the pubes.

(*e*). **Lordosis** may prevent the easy entrance of the head into the brim, and have the same result as a minor degree of antero-posterior contraction. A double sacral promontory may have the same effect.

Having dismissed the rare and unimportant forms, we now come to the important one.

(*f*). **Rickety Flat Pelvis.**—Five out of seven flat pelves are rickety in origin. The pelvis may be large or small, *i.e.*, the transverse of the brim may be of normal length; but very often there is some general contraction in addition to flattening. Thus there is no hard line between the rickety flat pelvis and the rickety generally contracted pelvis. In practical obstetrics the mechanism shows whether the flattening or the general contraction is the predominating deformity. The more flattened forms are due to softening of the bones at an early age, before walking and standing can exert an inward pressure at the acetabula, and when constant sitting exaggerates the eversion of the ischia. The actual size of the pelvis depends on the degree in which growth of the bones is checked by the disease.

Lordosis is present, the inclination of the brim is in-

creased, the body weight acts too far forward, and an unduly large component of it acts in the plane of the brim, widening it transversely.

In the false pelvis the ilia are thick and stumpy, their arching and sinuosity is not diminished, the anterior superior spines are thrown apart so that the interspinous diameter approaches, equals or even exceeds the intercristal.

The brim is kidney-shaped (rarely elliptic), and its inclination is increased. The promontory projects, the

FIG. 43.—Rickety Flat Pelvis.

conjugate is shortened, and the transverse is relatively increased.

The cavity is broadened, the sacrum being broad, short, and flat. The outlet is enlarged, the pubic arch being wide, the ischial tuberosities far apart, and the sacrum often straightened out. The coccyx may be pressed backward, or doubled up on itself and tilted forward.

The **diagnosis** is aided by shortness of stature, bent limbs and the forward curve of the loins. The sacrum is depressed unusually, the dimples marking the superior-posterior spines are often exaggerated, and the muscles and ligaments of the back are stretched across the hollow behind the sacrum. The interspinous diameter is in-

creased relative to the intercristal. The external conjugate is short, being less than $7\frac{1}{2}$ inches as a rule. The diagonal conjugate is short, and the promontory easily felt, but there is room laterally and the outlet is large. During labour the head may be found arrested at the brim and lying in the transverse, the mechanism of labour pointing to the diagnosis.

The **prognosis** depends on (1) the degree of contraction of the conjugate and (2) the amount of room available in the transverse. Flatness is much less unfavourable to mother and child than other deformities with the same antero-posterior contraction. When the brim is passed all trouble is over, though the straightness of the sacrum may allow the head to descend directly on to the pelvic floor, causing rupture of the perineum.

Mechanism.—The long diameter of the head lies in the transverse, Solayres obliquity being absent. One parietal bone is usually lower than the other, the sagittal suture approaching the promontory or more rarely the sacrum. Thus Naegele obliquity is commonly present, less frequently its reverse. The head is caught between the sacrum and the symphysis, more or less in front of the parietal eminences. Flexion is thus prevented, as the broad posterior part of the head cannot enter the brim, but passes, if there is room, towards its own side of the pelvis, so that the short bi-temporal diameter lies in the conjugate. Some extension of the head occurs, the forehead dipping, so that Michaelis obliquity is characteristic of the mechanism in flat pelvis. In most cases the posterior parietal rounds the promontory and is grooved almost vertically, or even fractured in the process. In those cases where the posterior parietal descends first, the sagittal suture being near the pubes, the anterior parietal rounds the symphysis, while the promontory indents the posterior parietal and somewhat arrests its progress. Once through the brim, the rest of the descent is easy, as the roomy cavity and outlet offer

no further resistance to the passage of the head. Rotation occurs as usual when the leading part strikes one lateral half of the pelvic floor. If the transverse is contracted so that general contraction preponderates over flattening, the mechanism will be that of general contraction, flexion occurring, and the parietal bone being grooved longitudinally as it passes over the promontory.

Treatment.—The first stage may be slow, owing to the imperfect fitting of the head into the lower-uterine segment, and this may call for treatment. The membranes should be preserved intact as long as possible, but are likely to rupture early. If this occur, Champetier de Ribes bag may well be used to replace the fore waters, as the head, arrested at the brim, may be unable to descend and act as a dilator.

The discussion of the question as to whether forceps or turning is the proper treatment in flat pelvis will be found in the section on the use of the forceps. Turning is the classical treatment. This may be done early by the bi-polar method, if the membranes are intact, or by the internal method as soon as possible after their rupture. If the case is not seen till the liquor amnii has escaped completely, turning is difficult and dangerous, and forceps should be used. It is probably better to use forceps, provided that the axis-traction instrument can be obtained, in all cases where a living child can be delivered. This can be done with a roomy transverse when the conjugate is reduced to about 3 inches. The forceps may be applied soon after dilatation is complete, as this saves exhaustion to the mother and risk to the child, and causes no danger if extraction is not hurried. Walcher's position is very useful in these cases. When the forceps fail, symphysiotomy or embryulcia are the alternatives. Symphysiotomy may succeed with a conjugate as small as 2½ inches. Embryulcia is difficult even in flat pelves with a conjugate of 2 inches. Abdominal section may be necessary. Prema-

ure labour may be successful with the conjugate from $3\frac{1}{2}$ to about $2\frac{3}{4}$ inches.

In transverse presentations podalic version should be done, as it is not worth while to endeavour to make the head present. If the head stick, perforation of the aftercoming head through the mouth is easy and successful. In all pelves with general contraction, however, every endeavour should be made to perform cephalic version, as the delivery of the aftercoming head is very difficult in these pelves.

V. The Triradiate or Compressed Pelvis.

(*a*). **True Malacosteon.**—The triradiate, rostrate or beaked pelvis is due to extreme softening of the adult bones by

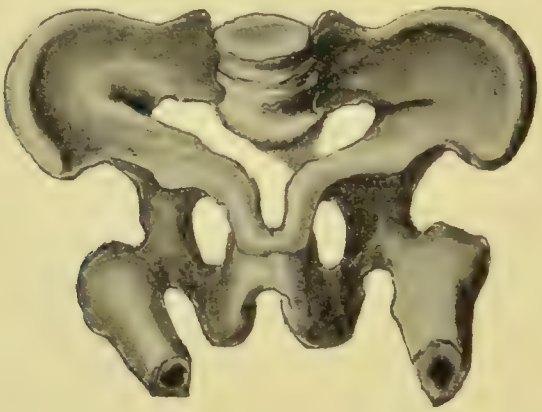


Fig. 44—Malacosteon Pelvis.

mollities ossium. In standing, three forces press the pelvic walls inward, the body weight acting on the promontory, the resistances of the two legs on the acetabula. In sitting, the resistance of the ground pushes inward the ischia, already inverted by pressure on the acetabula during standing. The false pelvis is marked by the bending round of the ilia into a form sometimes compared to that of a sugar scoop, the anterior superior spines nearing one

another. The pubes give way and bend inwards at the thin parts of the superior rami, the pubic symphysis doubles up and projects forward, forming the beak or rostrum. The promontory is pressed forward so that the brim assumes a triradiate shape. The cavity is narrowed. The sacrum is doubled upon itself. The pubic arch becomes excessively narrow, and the ischial tuberosities approach one another closely.

(*b*). **Pseudo-Malacosteon.**—The Rickety Rostrate or false beaked pelvis is produced by the action of the mechanical forces on a pelvis very much softened by rickets at a late stage when the child is running about. The growth of the bones is impaired in addition to the softening, so that the pelvis is small. The pubic symphysis projects as a beak. The anterior superior iliac spines are widely separated as in other rickety pelves, the ilia being flattened out instead of folded into a scoop shape. The deformity is not so extreme as in the true malacosteon pelvis, which, however, it closely resembles.

Diagnosis of triradiate pelvis.—Mollities ossium often first appears during a puerperium with the occurrence of severe rheumatic pains. The woman leaves her bed, and bending of the bones then occurs. At her next labour there is difficulty and the condition is diagnosed. Beaking of the pubes and narrowing of the pubic arch are easily recognised. Other bones may become deformed and their softness may be obvious. The rachitic form is distinguished from the malacosteon by the history and other evidences of rickets, by the hardness of the bones, by the small size of the pelvis, and the separation of the anterior superior spines.

The Prognosis is grave, as both conditions often demand the most serious forms of interference, and osteomalacia is progressive.

Treatment.—In true malacosteon pelvis the bones may be soft enough to allow of the extraction of a living child. Delivery, in minor degrees of contraction, may be accom-

plished by forceps or embryulcia. Porro's operation is the best treatment, as it arrests the disease. In the triradiate rickety pelvis the hardness of the bones makes extraction of a living child more difficult than in the malacosteon. Embryulcia or abdominal section is usually indicated.

8.[1] **Tumours of the Hard Parts.**—Various bony tumours of the pelvis may cause irregularities of form and obstruction in labour. These do not fall conveniently into the groups of contracted pelvis, so are mentioned together here. Some of these are true exostoses, single or multiple. Some are osteo-sarcomata, others are masses of callus, remaining after fractures of the pelvis, and others, again, are the result of so-called rheumatoid arthritis. Some interesting forms known as "spiny pelvis" are due to ossification at the insertions of ligamentous and tendinous structures, and the exaggeration of the natural ridges and eminences of the bones. In the minor conditions extraction of living children by forceps or premature labour is possible. Embryulcia is often demanded, but if there is not a free space measuring at least 2 by 3 inches, a cutting operation is usually safer for the mother.

Causes of Delay in the Second Stage—*Continued.*

III. Faults in the Passenger.

1. **Shortness of the Cord.**—This may be "absolute" when the cord is only a few inches in length, or "accidental" when it is shortened by being wound round and round the neck or body of the child. Absolute shortness sufficient to delay labour is rare, accidental shortness is more frequent. Early separation of the placenta, rupture of the cord, or compression of the cord, may cause the death of the child. Inversion of the uterus may occur. Most cords break under a weight of $8\frac{1}{4}$ pounds. The weakest give way

[1] (7 on page 287.)

under $5\frac{1}{2}$ lbs., the strongest only under 15 lbs. Thus a short cord may resist the expulsive powers to the extent of 15 lbs. weight (Duncan). The diagnosis is difficult, as the head is almost always born before the delay begins. Rectal examination may reveal the presence of coils of the cord round the neck. Treatment consists in passing the loop of cord over the head or shoulders, or in cutting the cord between two ligatures.

2. **Death of the Child** is mentioned as a cause, but it is rather a result of delay. Cases, however, are recorded in which *rigor mortis* of the child has been said to occur in utero, and to hinder expulsion for a time.[1] Decomposition may cause various parts to be distended with gas, producing *Emphysema* of the foetus. If delivery is impeded, the abdomen may be punctured and the skin incised in various places to allow the gas to escape.

3. **Large size of the Child.**—A large child, weighing 12 lbs. or more, may have a head which is too large to enter the brim of a normal pelvis, and the large size of the body may form an additional impediment. It is noted that the head is larger in a woman's later than in her earlier pregnancies. The male head is slightly larger than the female head, and the birth of males is more dangerous to both mother and child than that of females. If the pelvis is normal, heads of this class can usually be pulled through with forceps, especially if Walcher's posture be used. The head moulding and caput succedaneum are apt to be excessive, and cephalhaematoma may be produced. The worst cases may call for symphysiotomy or perforation of the head.

4. **Unduly ossified Skull.**—The bones of the skull may be hardened by premature ossification and united too firmly at the sutures. This prevents head-moulding, and may cause the head to be arrested at the brim or in the cavity of the pelvis. The condition is recognised on vaginal examination, and may call for operative interference.

[1] W. J. Ballantyne, Trans. Edin. Obstet. Soc., 94-95.

5. **Enlargement of Head or Body by Disease.**

(*a*). **Congenital Hydrocephalus.**—This occurs once in 900 or 1000 cases. Fluid distends the cavities of the brain, or rarely the sub-arachnoid space, producing a head of enormous size, *e.g.*, 33 inches in circumference. The sutures and fontanelles are wide as a rule, the bones being thin and parchment-like. In some cases of slight distension the bones cover the whole surface, being united at the sutures, but much thinned. The body is frequently small and shrunken. Pelvic presentations are frequent. Labour is delayed, and the head may pass the brim after being crushed by the natural powers. Frequently prolonged labour ends in rupture of the uterus or in complete exhaustion. Rupture occurred in 16 out of 74 cases. Death and maceration of the child favour spontaneous rupture of the cranium, with escape of the fluid, after which natural expulsion may occur. The risk to the mother is very great when the condition is not recognised and treated early. The child, as a rule, soon dies, even if born alive, and the mother should be exposed to no risk in order to preserve its life.

The diagnosis is made by bimanual palpation of the head, which is large, soft and compressible, the bones yielding before the finger in a way suggestive of brown paper. Anaesthesia greatly aids in the examination.

The treatment consists in perforation as soon as the diagnosis is complete. It is not worth while to try forceps or turning in head cases. In breech cases perforation may be done through the mouth or behind the ear. After perforation the head may descend naturally. If it does not do so it may be extracted with a cranioclast. An aspirator may be used for withdrawing the fluid if it be desired to give the child a chance of life.

(*b*). **Encephalocele, Hydrorachitis, Hydrothorax, Ascites, General Oedema, Hydronephrosis, Hydrocele.**—These may all produce collections of fluid which may delay labour. If

nature fails to cause expulsion in a reasonable time the fluid must be drawn off with an aspirator, or otherwise allowed to escape.

(*c*). **Tumours,** simple or malignant in type, may be external, or may cause enlargement of various viscera. These are usually diagnosed late in labour, it may be after escape of the head. Traction may be sufficient to complete delivery, or it may be necessary to perforate the enlarged part.

(*d*). **Monstrosities.**—In anencephalic monsters the brain and vault of the skull are wanting, the neck is short, and the face looks upward. Pelvic and transverse presentations are frequent. In head cases the face presents, which may cause difficulty in diagnosis. Delivery is easiest head last, for the small head does not dilate the passages enough to admit of easy escape of the shoulders. Turning is therefore useful.

Exomphalos consists in extroversion of more or less of the abdominal viscera, which protrude from the unclosed abdominal cavity, and usually afford attachment to the cord, which is often short. The extroverted mass may present and may be mistaken for placenta, or otherwise confuse the diagnosis. In these cases, version should be performed. Labour is not delayed as a rule, but the shortness of the cord may impede expulsion. Double monsters are mentioned under the complication of labour by plural birth.

6. **Malposition of the Head.**—Malpositions and interference with normal mechanism due to deformity of the pelvis have been mentioned under "Contracted Pelvis." The mechanisms possible in occipito-posterior cases have been described with those of other vertex cases. In any occipito-posterior case labour will be prolonged, for time is occupied in the long rotation of the occiput to the front if this occur. If short rotation of the sinciput to the front occur, and the case become persistent occipito-posterior, difficulty is inevitable and delay considerable. The danger to the

perineum is great, (1) because the broad part of the head presses upon it, and (2) because room is wasted by failure of the forehead to fit into the pubic arch, and this demands unusual stretching of the soft parts, the whole head being pushed farther back than usual.

Treatment.—In non-malrotated occipito-posterior cases, flexion, and with it long rotation, may be promoted either by pushing the sinciput upward and backward, or by traction with forceps.

In malrotated or persistent occipito-posterior cases extraction by forceps is usually necessary. Extreme care must be used to preserve the perineum, and it may be well to incise it freely at both sides, rather than run the risk of a tear in the middle line which might involve the anal canal.

7. **Malpresentations of the Head.**

(*a*). **Parietal** or "ear" presentations occur in flat pelvis.

(*b*). **Occipital** presentations occur in justo minor and other generally or obliquely contracted pelves, the head presenting a small circumference to the brim at the beginning of labour. The same early flexion occurs when a large head engages in a normal pelvis.

(*c*). **Brow, Forehead, or Frontal Presentation.**—In this the sinciput is too low at the beginning of labour, flexion being less than normal. (1) The head may be arrested in this position; (2) further extension may occur, producing a face presentation (which see); (3) or possibly flexion may occur and the vertex descend. Brow cases are rare, they are diagnosed by the ease with which the anterior fontanelle is reached. The posterior fontanelle cannot be touched, but the face is accessible. The commonest position is simply an L O A modified by extension, *i.e.*, the anterior fontanelle looks forward and to the left. The "caput" is over the frontal suture, the nose and bregma are flattened. The condition is due to the causes of face presentation acting in a minor degree.

The treatment at first consists of promoting flexion or extension so as to produce a vertex or a face presentation.

If this is not successful, forceps must be applied and the head extracted as best it can. Perforation may be necessary.

(*d*). **Face Presentation.**—This occurs once in about 200 cases. The head may be extended before labour due to "primary" causes, or during labour due to "secondary" causes.

Palpation may reveal extension of the head weeks before the onset of labour. Obliquity of the uterus, malformation of the child (anencephalic monster) and deformity of the pelvis are amongst the causes. It is said by those who espouse the "lever theory" of flexion (see page 215) that excessive dolicho-cephaly or elongation of the child's head may cause the vertebral column to be attached nearer the front than the back of the head. They hold that, when this is the case, the long and short ends of the lever being reversed, the pressure of the uterus transmitted to the head by the spine will force down the face instead of the occiput. Death of the child, by reducing the tonicity of its body, favours face as it does other irregular presentations.

The positions in face presentation correspond to those in vertex presentation. The chin or mentum is the denominator, and passes to the front in rotation. Extension of the head turns the left occipito-anterior into the right mento-posterior and so on, thus :—

1. LOA = RMP. Right mento-posterior (1st in frequency).
2. ROA = LMP. Left „ „ (3rd „).
3. ROP = LMA. Left mento-anterior (2nd „).
4. LOP = RMA. Right „ „ (4th „).

The **mechanism** in face cases is just the converse of that in vertex cases, four movements being described, which occur together with descent of the head. In **mento-anterior** cases they are as follows :—

1. **Extension.**—At the beginning of labour the forehead is accessible, but the chin descends in a movement of extension.

2. **Internal Rotation.**—When the chin strikes persistently one lateral half of the pelvic floor, it is rotated to the front through $\frac{1}{8}$ of a circle and passes under the pubic arch.

3. **Flexion.**—The back of the head passes over the perineum, and the head escapes.

4. **External Rotation.**—As the leading shoulder comes to the front, the face turns to one side or other as the case maybe.

In **mento-posterior** cases two mechanisms may occur just as in occipito-posterior cases.

Most frequently long rotation of the chin to the front occurs, thus :—

1. **Extension.**

2. **Long rotation of chin** to the front through $\frac{3}{8}$ of a circle.

3. **Flexion.** 4. **External rotation.**

Less frequently extension is replaced by flexion, and the forehead, descending in advance of the chin, is rotated to the front through $\frac{1}{8}$ of a circle, while the chin passes into the hollow of the sacrum. This is malrotation of a mento-posterior case, resulting in the persistent mento-posterior position in which natural expulsion is almost impossible.

1. **Flexion.**

2. **Short rotation of forehead** to the front through $\frac{1}{8}$ of a circle.

3. **Extension.** 4. **External rotation.**

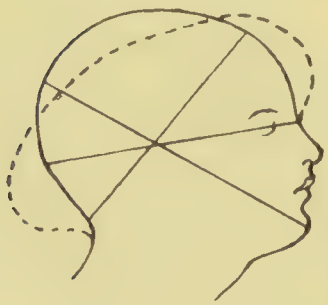


FIG. 45.—Head moulding in face cases.

Head Moulding and Caput Succedaneum. — The parietal bones are flattened and the frontals and occipital are bulged and curved. The sub-occipito-bregmatic diameter is lessened, while the occipito-frontal is considerably, and the occipito-mental slightly increased. The primary caput is formed about the level of the eyes or even higher. As the chin descends, the caput passes down the face, and the secondary caput is about the level of the mouth. The eyelids, lips and cheeks are much swelled and congested, and blood may be effused into the conjunctivae.

Diagnosis.—The position may be recognised by abdominal palpation, but is usually diagnosed when the soft irregular face is felt, through the membranes or after their rupture. Care must be used to avoid injuring the eyes. The glabella, nostrils, orbital ridges, mouth and chin are distinctive. The face has been mistaken for a breech, the mouth being thought to be the anus.

Prognosis.—Labour is usually delayed. The first stage is slow because the face does not form so good a dilator as the vault of the skull, and does not allow of the formation of so good a bag of waters. If the chin descends well the second stage may end naturally, but in malrotated or persistent mento-posterior cases interference is usually necessary. The risk to the child is greater in face than in vertex cases, in the proportion of 13 to 5, according to the records of still-birth. This is due to delay and the need for interference. The risk to the mother is not much increased. The causes of face presentation, *i.e.*, obliquity of the uterus and deformity of the pelvis, also tend to cause delay, and mar the prognosis.

Treatment.—The membranes should be preserved intact as long as possible. As face cases are not very favourable ones for the forceps, labour should be allowed to end naturally if possible in spite of some delay. If labour is in an early stage the presentation may be changed to the vertex, or podalic version may be performed. At a later stage the forceps must be used in cases of serious delay. In mento-posterior positions, descent of the chin and long rotation should be favoured by pushing the sinciput upward and backward. Persistent mento-posterior positions cause great difficulty. The chin lying in the hollow of the sacrum, the head becomes firmly impacted. The forceps may succeed, but perforation may be necessary to admit of extraction.

(*e*). **Head presentations complicated by malposition of the Arms.**—Prolapse of the hand or of the whole arm is said to occur once in about 500 cases. The fingers may

be felt beside the head before the rupture of the membranes, or after that occurrence the arm may be found prolapsed into the vagina. The most troublesome form is the nuchal or dorsal displacement of the arm, in which the forearm lies across the back of the neck, forming an obstruction too high up to be felt without introducing the hand past the head.

In some cases labour may end naturally, or with the help of forceps without reposition of the arm. In others the arm must be replaced, care being taken to move it toward the front of the child's body. In the nuchal displacement the arm must be straightened at the elbow till it lies beside the head, it must then be carried forwards towards the child's face, till, being brought to the front, it can be replaced above the head, or admits of delivery. Version may be performed when the condition is diagnosed sufficiently early.

Summary of Causes of Delay in the Second Stage.

I. Faults in Powers.	1. Inefficiency of the Accessory Powers. 2. Inefficiency of the Uterus.
II. Faults in Passages.	1. Narrow Vagina, &c. 2. Distended Rectum, &c. 3. Enterocele. 4. Bladder. Distension, &c. 5. Ovarian Tumours, &c. 6. Fibroid Tumours, &c. 7. Abnormal Pelvis. 8. Tumours of Hard Parts.
III. Faults in Passenger.	1. Short Cord. 2. Death of Child. 3. Large Size of Child. 4. Unduly Ossified Skull. 5. Enlargement of Head or Body by Disease. 6. Malposition of Head. (Occipito-posterior, *e.g.*) 7. Malpresentation of Head. (Face Case, *e.g.*)

CHAPTER XVI.

PRAETERNATURAL LABOUR.

HAVING ended the consideration of I. Natural, or "head first" labours, we now pass on to II. Praeternatural Labours, those in which the presenting part is—**1. The breech or lower extremity**; or, **2. The trunk or upper extremity.**

The causes of praeternatural labours are those mentioned on page 89. They are diagnosed before labour by abdominal palpation; or during labour, by slowness of the first stage, irregularity of the bag of waters, inaccessibility of the presenting part, and peculiarities of that part when felt.

I.—PELVIC PRESENTATION.

Causes.—These may be enumerated as—1. Excess of liquor amnii. 2. Contracted Pelvis. 3. Tumours. 4. Obliquity of the Uterus. 5. Multiple Pregnancy. 6. Hydrocephalus. 7. Monstrosity, Death or Prematurity of the Foetus. 8. Placenta Praevia.

Frequency and Varieties.—Pelvic presentation occurs about once in 33 cases. The varieties are three:—**Breech, Footling,** and **Knee.** The foetal attitude is the usual one of flexion in both Breech and Footling presentations. The difference between these is simply one of direction of the long axis of the foetus. Thus if the foetus is lying back, so to speak, the breech is lower than the feet, is first palpable, and forms the presenting part; while, if the foetus is lying forward, the feet are lower than the breech, and descend

before it. In knee presentation, which is excessively rare, the foetal attitude is undone. Extension of the legs at the knee sometimes occurs, the feet then being up near the fundus.

Diagnosis.—Palpation reveals the presence of the head at the fundus. The point of maximum intensity of the foetal heart sounds is above the umbilicus. The membranes often rupture early, and meconium discolours the vaginal discharge. The soft presenting part is recognised as the breech by finding the sacrum, coccyx and ischial tuberosities. The anus is not in a depression, as there is no great mass of gluteal muscle in the foetus. The crest of the ilium may be found, and the finger passed into the groin, which is distinguished from the axilla by the absence of ribs. Kicking movements may be felt. The foot is distinguished from the hand by the presence of a heel, and by the fact that the ends of the toes are almost in one straight line. The two feet are usually close together.

Prognosis.—The mother is only endangered by slight delay in labour, and by interference in favour of the child. It is said that one child in five is lost. The dangers to the child are suffocation through respiratory efforts commencing before the head is delivered, and asphyxia through compression of the cord, which may occur as soon as the umbilicus has escaped from the vulva. Compression of the placenta by the uterus may stop the foetal circulation while the head is in the vagina, and attempts to complete delivery may also injure the child.

Positions.[1]—The sacrum is taken as denominator, as it

[1] Some object to the nomenclature for the positions of the breech with the sacrum as denominator. Hart defines position as the relation, to the upper strait of the pelvis, of that part which should first rotate to the front in internal rotation. In breech cases it is the anterior hip which rotates to the front; thus, if the back of the child be to the front of the mother, either the child's left hip will be to the front and right (=L S A), or the child's right hip will be to the front and left of the mother (=R S A). If the back of the child be to the back of the

FIG. 46.—Waldeyer's Section. Before labour. x-para at full time. This section also illustrates Chap. xiii., p. 230.

corresponds to the back of the child, and so to the occiput. Four positions are thus named, corresponding to the four positions in vertex presentations :—

1. Left sacro-anterior	L S A	First in frequency.	
2. Right ,,	R S A	Third	,,
3. Right sacro-posterior	R S P	Second	,,
4. Left ,,	L S P	Fourth	,,

Mechanism.—A small foetal breech may pass straight through the pelvis; but, as a rule, a descent of the anterior hip occurs which corresponds to flexion. The anterior hip thus first strikes a lateral half of the posterior segment of the pelvic floor, and is pushed to the front in the movement of trunk rotation. It must be carefully remembered that it is not the sacrum which comes to the front. The anterior hip then escapes under the pubic arch, while the posterior hip passes over the perineum in a movement which may be compared to extension. The head enters the pelvis with its long axis in the transverse, and rotates as it descends, the occiput coming to the front and the chin passing into the hollow of the sacrum. While the head performs this internal rotation the trunk makes a corresponding rotation external to the mother's body.

The arms should descend before the head, which should remain flexed, the chin, face and brow passing in turn over the perineum. The parts free from pressure become

mother, its right hip will be to the front and right (=R S P), or its left hip will be to the front and left (=L S P). Hart therefore proposes the following nomenclature, which is accurate, logical, and simple, and describes the mechanism. "Right" and "left," "anterior" and "posterior," all refer to the mother.

Dorso-anterior	Right coxa-cotyloid	=L S A.
,,	Left ,,	=R S A.
Dorso-posterior	Right ,,	=R S P.
,,	Left ,,	=L S P.

A similar nomenclature is proposed for transverse cases. See Hart's Selected Papers, p. 77.

oedematous, red and congested, as in the formation of a caput succedaneum. The scrotum and genitals may be greatly swelled.

Management of Pelvic Cases.

FIRST STAGE.

Do not attempt to alter the presentation ; but inform the relatives of its nature, and mention the *risk to the child.*

Preserve the membranes intact as long as possible, and aid dilatation, if necessary, by warm douches and emollients.

SECOND STAGE.

Do not interfere till the breech is expelled, so that the parts may have time for full dilatation before the birth of the head. When the trunk is born as far as the umbilicus, pull down a small loop of the cord, observe the pulsation in this, and do not interfere unless it begins to fail. The exposed parts may be wrapped in warm cloths in order that respiratory efforts be not induced by contact with the cold air. Delivery should not be hurried unless the child is in danger, as the bulkiest part has yet to pass, and may cause tearing of the cervix, vagina or perineum. The hands may be freed when they can be reached.

If spasms of the body indicate that respiratory efforts have begun, or if pulsation fails in the cord, aid delivery by pressure on the fundus, which preserves flexion of the head and does not cause displacement of the arms. Gentle traction in the pelvic axis should only be used as supplementary to supra-pubic pressure, which prevents relaxation of the uterus as well as preserving the mechanism, and should never be omitted.

When the head only remains unborn it occupies the passive part of the parturient canal, the expulsive power of the uterus can act upon it no longer, and the uterus being

almost empty, the accessory powers also act on the head at a great disadvantage. To save the life of the child it is thus usually necessary to deliver the head at once. In doing this the desideratum is to promote flexion. Suprapubic pressure should be continued by an assistant. The child's body must be carried well forward between the legs of the mother, and pressure must be applied to the head so as to secure descent of the chin. This may be done by placing the child astride of the left arm, the fingers of the left hand, in the vagina or rectum, applying downward and forward pressure on the malar bones. The right hand meanwhile covers the child's shoulders, and its fingers apply strong upward and backward pressure upon the occiput (German grip). Another way is to seize the legs with the right hand, and use traction by carrying them very far forward, while the left hand applies pressure on the occiput (Smellie grip). A third way is to seize the legs and carry them far forward with the right hand, while the left hand brings down the chin by pressure on the malar bones. The fingers may be put in the mouth, and traction used on the lower jaw instead of on the malar bones. This may easily injure the child, so should be avoided as a rule, though in the case of a dead foetus it is very useful. Forceps or perforation may be necessary, as indicated below, under "Impaction of the aftercoming head" (page 325).

Causes of Delay in Pelvic Cases.

In the first stage.—The girdle of resistance does not grip the breech so well as it does the head. The fore waters are not shut off completely from the hind waters, and the membranes thus have to bear the whole force of uterine pressure. Early rupture is therefore frequent. The labour then becomes a dry one, and delay is caused, as the unprotected breech is a still worse dilator than the unprotected

head. The various methods of artificial dilatation may be used.

In the second stage.—Impaction of the breech may be caused by large size of the child, by rigidity of the soft parts, contraction of the pelvis, or, indeed, by any of the maternal causes of delay in head presentations. The attitude of the foetus may also cause impaction of the breech. When the legs are extended, the feet being near the head, and the pelvis flexed upon the trunk at the lumbar articulations, the trunk, pelvis and legs of the foetus form a wedge which cannot pass through the maternal pelvis. As flexion of the foetal spine is necessary for this form of impaction, it cannot occur when one or both legs are down, and is removed by bringing down a foot if this can be done.

If the knees are flexed the feet may be reached, and by pulling down one or both legs the size of the breech may be so reduced that nature can complete its expulsion. If the legs are extended and the feet are near the fundus, traction may be exerted by a finger passed into the groin. A blunt hook may be used for this purpose, but is liable to cause injury. A better instrument is a soft aseptic handkerchief. One end is slipped into the groin, caught on the other side and pulled down between the legs. A gum elastic catheter, with its stylet in it, is useful for passing the handkerchief. The tips of the two index fingers may be made to meet round one thigh, and form a good tractor. The forceps may be applied to the breech, but a good grip is difficult to obtain. In some cases the breech can only be extracted after comminution with a cephalotribe. After this operation the head should always be perforated before its delivery is attempted, both because an unperforated head will not pass where a breech has failed to do so, and in order that the mangled infant may not be born alive.

Upward displacement of the Arms.—This accident is

usually caused by traction on the legs and the omission of supra-pubic pressure. It also occurs frequently when the lower limbs are in an unusual position. The arms being extended beside the head, descent of the latter is effectually prevented. The arm which is most accessible must first be replaced, the child's trunk being swung well backward or forward as the case may be. The fingers should be passed upward till the elbow is felt, the arm must then be moved toward the child's face, brought down in front of it, and disengaged. The trunk being swung in the opposite direction, the other arm must next be freed. The greatest care is necessary to avoid injuring the arms. Separation of the diastasis from the epiphysis at the upper end of the humerus is the common accident; fractures of humerus or clavicle also occur.

Impaction of the aftercoming Head.—This may be due to large size of the head or to narrowness of the parturient canal, but it is usually caused by extension of the head, and this is, as a rule, produced by the use of traction and the omission of supra-pubic pressure. The methods of extracting the head in an ordinary breech case may be successful even when the head is more or less impacted, as they are directly intended to promote flexion. Pressure through the abdominal wall should be vigorously employed, and it is found useful to adopt a dorsal posture. Forceps act admirably on the after-coming head, as they take a very favourable grip. The disadvantages are that a little time is spent in applying them, which is a rather more difficult task than in head-first cases. The child's body must be held well forward out of the way, the forceps being applied in front of it, so that the occiput is at the tip of the blades and the chin between their bases. Traction in the proper axis then rapidly delivers the head. Great care must be used to make the uterus contract firmly, as it often fills with blood during the manipulations necessary to extract an aftercoming head. Perforation may be necessary and is not difficult.

Malrotation.—In a few rare cases the chin comes to the front and the occiput passes into the hollow of the sacrum. This is an awkward accident, and causes great difficulty. Birth occurs by the passage of chin, face and forehead in turn under the pubic arch, and it is important to direct all efforts towards producing this mechanism. Thus the body must be swung backward instead of forward, the occiput pressed up and forward through the rectum, and the chin brought down and backward. It is easy to remember that *in all head-last cases the chin should be born first.* Forceps are not at their best in this position of the head, as they do not sufficiently promote flexion nor prevent further extension. The chin is said to remain occasionally arrested above the pubic arch, the face looking up toward the abdomen and the occiput being low down in the sacral hollow. In this case the occiput would have to pass first over the perineum, the face being born last. Only a very small head could escape in this way, and perforation of an ordinary head would be essential.

Gripping of the Head by the retracting portion of the uterus may occur, the retraction ring closing upon the neck of the foetus. Free administration of an anaesthetic, followed by rapid delivery, is the only way of saving the child.

II.—TRANSVERSE PRESENTATIONS.

Causes.—The causes of cross or transverse presentation have already been discussed amongst causes of malpresentation in general (page 89). They may be enumerated here as (1) excess of liquor amnii; (2) tumours; (3) contracted pelvis; (4) obliquity or disease of uterus; (5) placenta praevia; (6) twins; (7) death, prematurity, or malformation of the foetus.

Frequency.—Transverse presentation occurs once in about 240 cases.

Varieties.—The shoulder usually is the presenting part. The arm (hand or elbow) often presents, and, very rarely, the trunk (ribs) may first meet the finger.

Diagnosis.—Abdominal palpation before labour may discover the long axis of the child to be lying across the long axis of the mother, not at right angles to it by any means, but obliquely. The head will be found on one side, the breech on the other. The back is felt if it is to the front, the limbs if they are to the front, revealing completely the position of the child.

Per vaginam the presenting part is inaccessible and soft. If the shoulder be felt, three bony ridges are recognised—the clavicle, the humerus and the spine of the scapula—radiating from a central spot. The finger may be passed into the axilla, which is distinguished from the groin by the presence of ribs. The elbow offers to the touch the prominence of the olecranon with a hollow on each side of it; unlike the knee, in which the condyles of the femur are separated by a depression. A hand is easily recognised by the absence of heel, the inequality in length of the fingers, and the freedom with which the thumb can be bent over the palm. The bag of waters is usually finger-like or sausage-shaped. Care must be taken not to rupture the membranes while examining.

Prognosis.—The risk to the child is very great, as natural delivery can hardly occur with a living full-time child. Interference is usually by podalic version, which gives the risks of head-last delivery. The causes of transverse presentation are also unfavourable to the life of the child, and the inevitable delay exposes it to further danger—50 per cent. are lost. The risk to the mother increases as labour goes on, and at any stage varies with the skill and promptitude of the treatment, which is usually successful before the membranes are ruptured, but is much more difficult later. The main risks are delay, exhaustion, rupture of the uterus, and the results of operative interference.

Nomenclature and **Positions.**—The shoulder is made the denominator, and four positions corresponding to those of the vertex are named :—[1]

1. Left acromio-anterior, L A A.
2. Right ,, ,, R A A.
3. Right acromio-posterior, R A P.
4. Left ,, ,, L A P.

Course.—The labour may end in rupture of the uterus or the exhausted organ may cease to contract, and, when death and maceration have softened the foetus, it may be expelled in one of the manners described below. A small and flexible foetus is occasionally expelled alive; for instance, a premature foetus or one of twins.

Mechanism.—Natural substitution of the breech or even of the head is said to occur occasionally, and is known as Denman's "spontaneous version." For this there must be abundant liquor amnii and an elastic and resiliant foetus (alive or only just dead). The uterus must also be active, and the lower-uterine-segment must be undilated. "Spontaneous evolution" is the term applied to the more usual mechanism. With a wide pelvis and fully dilated parturient canal, and a small or dead and softened foetus, delivery occurs in this manner, according to Douglas.

1. Flexion of the head and body lets down the presenting shoulder, from which the head is bent laterally away.

2. The presenting shoulder strikes the pelvic floor, and is pushed to the front till it lies under the pubic arch, where it sticks.

3. The chest is now doubled upon itself and pushed

[1] Other authorities prefer to name the positions in a way corresponding to that they prefer for pelvic presentations. "Right" and "left" "anterior" and "posterior" refer to the mother.

1. Dorso-anterior, Left acromio-iliac = L A A.
2. ,, ,, Right ,, ,, = R A A.
3. Dorso-posterior, Right ,, ,, = R A P.
4. ,, ,, Left ,, ,, = L A P.

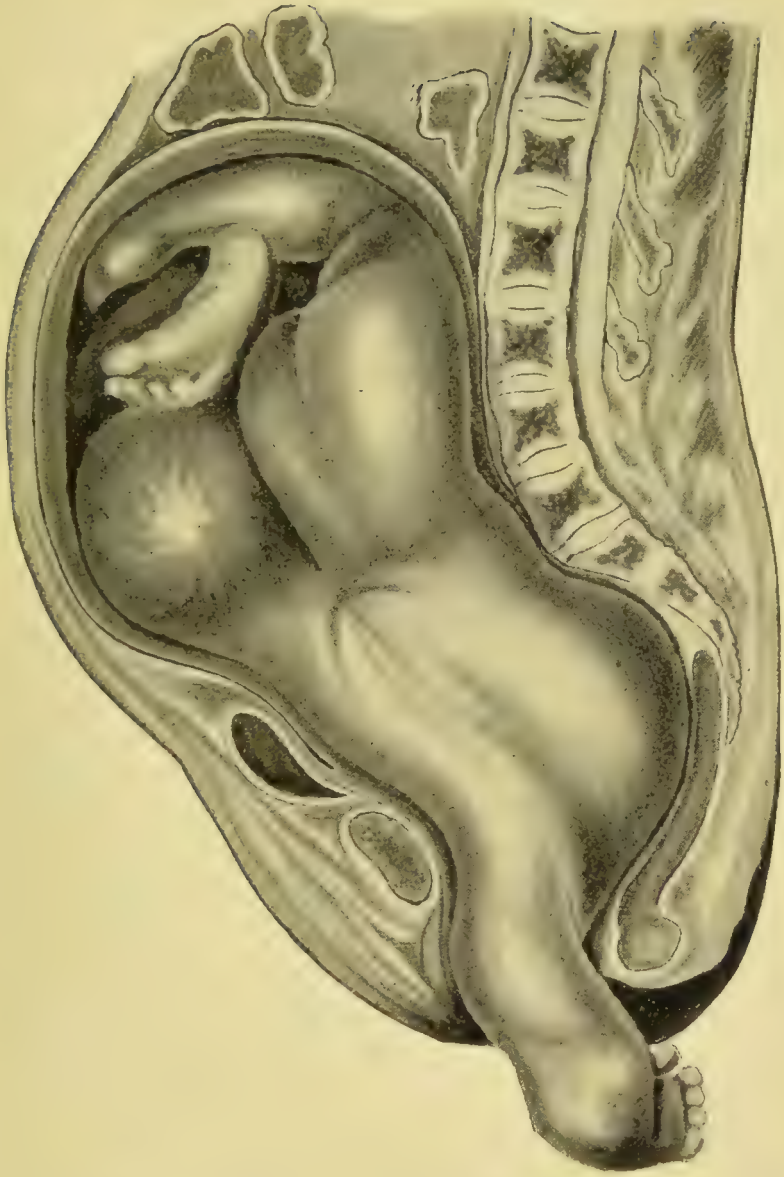


FIG. 47.– From Chiara's section of a woman who died during spontaneous evolution. This section also illustrates Chap. xiii., "Second Stage."

down past the shoulder, the abdomen following the thorax, the breech and, lastly, the legs following the abdomen, till only the head remains in the uterus.

4. The head then enters the pelvis and rotates as it descends, to be delivered as in other head-last cases.

In a very large pelvis, a small child may be pushed through doubled up, the head pressed into the abdomen, instead of remaining in the uterus till the breech and legs are born.

Treatment.—This is in all cases **version**, performed as soon as possible after the diagnosis is made.

If the membranes are not ruptured they must be carefully preserved, while version is done by the bi-polar method. **Cephalic** or **podalic** version may be chosen according to the respective ease with which they can be accomplished.

If the membranes are ruptured, **podalic** version by the internal method must be done. Chloroform should be administered to the full physiological degree, and the greatest care used to avoid rupture of the uterus (see page 362).

If turning is impossible, an attempt may be made to deliver according to the mechanism of spontaneous evolution, but no risk of injury to the uterus should be incurred.

Decapitation can be done, when the neck is accessible, by a blunt hook, a serrated hook or a sharp hook, and in various other ways. After this the body is easily extracted, and the head can be removed with forceps or in various ways.

Evisceration or removal of the contents of the abdomen and thorax is sometimes done when the neck is not accessible. It is much better to attack the spinal column, as recommended by Professor Simpson. This operation is known as **Spondylotomy**, and may be done with scissors or with a basilyst.

Presentation of Hands and Feet together.

This rare condition implies that the long axis of the child crosses the long axis of the uterus at an angle, and that the

presenting limbs are extended. The treatment consists of cephalic or podalic version by the bi-polar method if the case is seen early. Podalic version by the internal method must be done if the membranes have been long ruptured.

Presentation of Head and Foot.

This is still rarer than the last-mentioned condition. It occurs only with small or dead children, or through unskilled attempts at turning. The treatment is to pull down the foot and push up the head, after making sure that there are not twins in the uterus.

CHAPTER XVII.

COMPLEX LABOUR.

COMPLICATED or anomalous labours are those in which there is an element of danger to mother or child apart from the question of presentation. The various complications of labour may be divided into two classes. First, those arising on the part of the mother, and, second, those arising on the part of the child.

MATERNAL COMPLICATIONS.

UTERINE HAEMORRHAGE.

This subject is best discussed in three periods. The **first** includes the later months of pregnancy and the first and second stages of labour. During this period bleeding may occur from the separation of a placenta implanted **abnormally** so that part of it lies in the lower-uterine-segment (Placenta Praevia), or from the separation of a **normally** situated placenta. The **second** period is the third stage of labour, during which haemorrhage occurs in connection with some forms of retention and adhesion of the placenta. The **third** period is that immediately following expulsion of the placenta, during which post-partum haemorrhage may occur.

I. **Before expulsion of child** { Placenta Praevia. Separation of normally placed Placenta.

II. **During third stage.** Retained and adherent Placenta.

III. **After expulsion of placenta.** Post-partum Haemorrhage.

I.—HAEMORRHAGE BEFORE EXPULSION OF THE CHILD.

1. Placenta Praevia.

Definition.—Placenta Praevia is defined as the implantation of the placenta in such a position that some part of it is attached to that part of the wall of the uterus below the retraction ring, which is passive in labour, and is known as the lower-uterine-segment. This portion of the body of the uterus, at the end of pregnancy, is characterised anatomically by (1) thinness; (2) longitudinal arrangement of the muscle fibres in lamellae, which are easily separable; (3) loose attachment of the peritoneum; (4) the presence of a vein running round the uterine wall at its upper margin. Before labour it is hemispheroidal in form and its upper limit is from $2\frac{1}{2}$ to $3\frac{1}{2}$ inches above the os internum. During the first stage it is dilated into a canal continuous with that formed by the expanded cervix, the membranes being separated from its surface, which discharges a little blood constituting a "show."

The placenta is never attached to any portion of the cervical canal, but it may be implanted upon the lower-uterine-segment so as to cover completely the os internum. As a placenta so situated must of necessity be detached during the canalisation of the lower-uterine-segment, bleeding must occur from the ruptured utero-placental vessels. Such bleeding is, therefore, known as "unavoidable haemorrhage."

Frequency.—This implantation of the placenta is said to occur once in from 534 to 1564 cases, so its average frequency may be said to be about 1 in 1000 cases.

Varieties.—Three varieties are described—(1) **Central** or complete, when the os is completely covered by the placenta; (2) **Partial** or lateral, when the os is approached

or partly covered by the placenta; and (3) **Marginal**, when only the margin of the placenta extends into the lower-uterine-segment. It is obvious that a single case might appear to belong to two of these varieties at different times according to the degree of dilatation of the os. The classification is therefore valueless unless the degree of dilatation at the time of examination is stated, or unless it is understood that the condition after full dilatation is alone referred to.[1]

Source of the blood.—The muscular wall is thin and its fibres are mostly longitudinal. It is passive during labour, being stretched and elongated during the first stage. The mucosa covering it consists of a deep layer, a spongy layer through which separation occurs, and a compact layer of decidua which is shed with the placenta.

The **blood supply** of the lower-uterine-segment depends mainly, according to Hofmeier, on a branch of the uterine artery which passes downwards through the retracting portion of the uterine wall. This supplies the curling arteries which pass through the decidua to open into the intervillous space, from which blood returns by venous channels, again passing through the decidua to reach the venous sinuses in the uterine wall. Where the arteries and veins pass through the spongy layer of the mucosa, their walls are thin, as is seen in sections and shown by the ease with which they are torn at separation of the placenta.[2] When separation occurs normally in the third stage, bleeding from the utero-placental vessels is slight, because the retraction of the uterus has already compressed the branches of

[1] Hart therefore suggests the following use of terms:—

Central	= Covering the lower-uterine-segment.
Lateral	= Dipping into the lower-uterine-segment.
Marginal	= Reaching the os internum.
Overlapping	= Covering the os internum and passing up on the other side.

[2] See Hart, Selected Papers, p. 125.

the uterine artery and the venous sinuses in the uterine wall. But when the placenta is praevia, and these vessels are torn through in the first stage, the uterus is still large, and blood flows freely through its walls to and from the lower-uterine-segment. Thus profuse haemorrhage occurs from the arteries and veins of the **placental site**, and this is the main source of the haemorrhage. Blood has been stated to escape from the detached surface of the placenta, reaching it by the intervillous space from the portion of the placenta which remains attached. Clotting in the detached placenta prevents the occurrence of this soon after each cotyledon is completely detached; but while a cotyledon is partly attached and partly separated, blood may doubtless escape freely from its placental surface. Haemorrhage from this source and from the sinus of Meckel is insignificant compared with that from the bared placental site.

The **actual cause** of the separation of praevial portions of the placenta is the increase in area of the lower-uterine-segment during its dilatation from a hemisphere into a canal. Hart estimates the area of the undilated lower-uterine-segment at 15 square inches, and its area when dilated at 37.75 square inches. A disproportion very much less than this causes separation, as is seen when bleeding occurs before the actual onset of labour. Indeed, the slight expansion of the lower-uterine-segment and cervix during the later weeks of pregnancy is enough to account for many cases of haemorrhage during pregnancy from placenta praevia. In cases where bleeding occurs without any dilatation, the separation of the praevial placenta is doubtless due to causes which might separate a normally placed placenta. These cases are therefore, strictly, accidental haemorrhage from a praevial placenta. It is obvious that a praevial placenta is as much, and indeed more, exposed to accidental separation before labour than is a placenta in normal position.

There are certain cases in which a portion of the placenta, though extending into the lower-uterine-segment, remains attached throughout labour. These are, in all probability, cases of pathological adhesion of the placenta, so that they cannot be brought as evidence against the validity of the above explanation of the nature of placenta praevia.

Causes.—Placenta praevia frequently occurs in connection with uterine disease, displacements and new growths. It is more frequent in multiparae than in primiparae, and when it occurs in the latter they are usually somewhat advanced in life. It is probable that for some reason or other the ovum slips far down into the uterine cavity before becoming attached to the mucosa, so that the decidua serotina occupies from the beginning a lower position than usual. Hofmeier, Kaltenbach and others state that the condition is due to development of the placenta over the lower portion of the decidua reflexa. But villi developed in connection with the reflexa usually atrophy at an early stage, the blood supply of the serotina making it a much more favourable site for the development of the placenta.

Symptoms.—Placenta praevia may cause early abortions, but it usually causes no symptom till after the sixth month of pregnancy. The onset of haemorrhage is most frequent just before labour; it is sudden and unexpected, and may occur while the patient is at rest, and without any apparent cause. The bleeding may be slight, and may cease spontaneously, to recur a few hours or a few days later. On the other hand, it may be so profuse and persistent as to demand immediate and active treatment. During labour each contraction of the uterus reduces the blood supply of the lower-uterine-segment and checks the haemorrhage; but blood which has already escaped from the vessels is squeezed downwards and appears externally. This has given origin to the frequently reiterated, but misleading statement that in placenta praevia the haemorrhage occurs mainly during the pains. If much blood is lost the patient

presents the usual symptoms, pallor, weak rapid pulse, restlessness, sighing respiration, and tendency to syncope. The effects of placenta praevia are a tendency to premature labour, malpresentations, delay during the first stage, and a tendency to post partum haemorrhage.

Signs.—On vaginal examination the presenting part is not so distinctly felt as usual. A finger being introduced through the os, the placental mass may be easily recognised if it extends right across the aperture. Its margin may be found partly covering the os, or it may be necessary to pass the finger in some distance, till the edge of the placenta is found extending into the lower-uterine-segment. If the amniotic surface of the placenta can be touched it is recognised by the vessels which run over it under the amnion. The placenta should not be mistaken for blood clot.

Diagnosis.—In any case of sudden bleeding towards the end of pregnancy or early in labour, placenta praevia is at once suggested, the alternative being accidental haemorrhage from the separation of a normally situated placenta. Examination excludes the possibility of bleeding from the vagina or vulva, and, if a finger can be passed into the uterus far enough to detect placental tissue within the lower-uterine-segment, the diagnosis is complete. If the cervix will not admit the finger, a definite conclusion can not be formed. Ballottement is said to be difficult or impossible.

Prognosis.—The risk to both mother and child is very grave. It is greater the earlier bleeding commences, the less active is the uterus, and the larger the portion of the placenta attached to the lower-uterine-segment. The mother is exposed to danger by loss of blood, by operative interference, and by increased tendency to subsequent septic inflammation, general and local. The child's life is endangered by asphyxia and by interference, and, in many cases, also by prematurity and malpresentation. The mother has been said to die in 1 out of every $3\frac{1}{2}$ cases, but

with modern treatment many more are saved. From 60 to 75 per cent. of the children appear to be lost.

Palliative treatment.—When haemorrhage occurs during the later months of pregnancy the question arises whether palliative treatment is allowable. For though slight and of short duration, the bleeding may occur at any moment, and may be fatal before help can arrive. It is therefore seldom that any attempt should be made to continue pregnancy; but if the child is not yet viable, and the bleeding has been slight, it is desirable to prolong gestation sufficiently, at least, to secure the chance of delivering a child which can survive. If it is decided to use palliative treatment, the patient should be put absolutely to rest, in a cool and quiet room, perfect repose being secured by an opiate. Subsequently the diet should be carefully restricted, and a quiet, restful condition maintained. No vaginal plug or other local treatment should be used, which, by stimulating uterine contraction, could cause further separation of the placenta. Haemostatic drugs are not of much use in these cases, nor do local applications of cold afford any great advantage. At the first recurrence of bleeding, palliative treatment must cease.

Treatment.—There are three objects to be attained in treating a case of placenta praevia. (1) To **check the haemorrhage**; (2) to **dilate the cervix**; and (3) to **deliver the child.** In choosing methods of treatment the object should be to employ those which favour all of these ends, rather than those which accomplish one alone. Labour must be terminated without delay; and the difficulty which meets the operator time and again is to decide whether he will expose the patient to greater risk by the use of a slower or of a more rapid method.

The diagnosis of placenta praevia can be made as soon as the os will admit one finger. If the bleeding is not sufficient to cause immediate anxiety the **vagina should be plugged**, a measure which checks haemorrhage and pro-

motes dilatation at the same time. This may be done by inserting long strips of iodoform gauze or other aseptic material, with the help of a speculum, the end of each strip being left hanging out of the vagina to facilitate removal. A kite's tail made of pieces of cotton-wool tied on a string may be used, after being squeezed out of an antiseptic solution. Or a large Barnes bag may be placed in the vagina and fully distended with warm fluid, which should be antiseptic in case of leakage. Before plugging the vagina the bladder and rectum should be emptied. The vagina should be carefully douched with a hot antiseptic lotion at a temperature of 115° to 120° F.

The patient must not be left for long, and at the end of six or eight hours the plug or bag should be removed and a hot douche (115° to 120° F.) given. If there is no bleeding and no dilatation, it is allowable to replace the plug. If there is bleeding but not enough dilatation to admit two fingers, this degree of expansion of the cervix must be gained artificially. For this purpose the fingers may be used, or small hydrostatic dilators, preceded, if necessary, by Hegar's dilators.

Bipolar Version must then be performed. In order to pull down a leg it is necessary to rupture the membranes or to pass the fingers right through the substance of the placenta. The latter should never be done if the edge of the placenta can possibly be reached. By traction on the foot the child's breech is now to be drawn down into the lower-uterine-segment, so as to compress the site of bleeding. If the foetus is small, both feet may be pulled down. The breech now acts as a plug and as a dilator, and complete control over the haemorrhage is obtained. The rest of the labour should not be hurried. The uterus should be allowed to expel the breech, and birth should then be completed as in a pelvic presentation. For if delivery be attempted as soon as the foot is pulled down there is great risk of tearing the cervix, and adding the

danger from laceration to the mother's perils. Delivery should therefore be slow, even at the risk of the child's life. If bleeding continue, traction on the foot increases the pressure exercised by the breech, and at the same time accelerates the progress of labour. After delivery of the child it is best to separate and remove the placenta at once, as it is adherent in a large proportion of cases. If bleeding continue, the treatment then becomes that of post-partum haemorrhage. It must be remembered that in the worst cases it may be necessary to hasten delivery by craniotomy. Incision of the cervix may also be useful.

Other forms of treatment are advocated, and must be briefly discussed. Thus it is often stated that as soon as the condition is diagnosed the **membranes should be ruptured,** more especially if this can be done without injury to the structure of the placenta. The advantage of this measure is the single one of **checking bleeding**, and this it does not do nearly so well as in accidental haemorrhage. The disadvantages are that it **slows dilatation** by removing the bag of waters, and that it **hinders bipolar version** and makes internal version much more difficult. Thus rupture of the membranes may be sufficient to check the bleeding, but it may be insufficient, and then the **best treatment is prevented.** If the membranes have been ruptured, and turning is no longer possible, the best thing to do is to insert a **Champetier de Ribes' bag** into the lower-uterine-segment, distend it, and then, by traction on the tube through which it is filled, compress the site of bleeding and dilate the cervix. In this case the labour is best completed by **forceps**, so giving the child a much better chance of life than turning would do. It is very doubtful, however, whether rupture of the membranes, dilatation by de Ribes' bag, and extraction by forceps is as safe a course for the mother as packing the vagina and bipolar version. The great advantage of version is that it largely empties the uterus, which then retracts and

compresses the vessels above the retraction ring through which the lower-uterine-segment receives its blood supply.

Artificial rapid separation of the praevial portion of the placenta is a modification, advocated by Barnes, of the older treatment by separation of the whole placenta advised by Sir J. Y. Simpson. The latter expedient is not now used, but it may be useful to sweep the fingers round the lower-uterine-segment, separating the placenta from it in certain cases. For if the child is already dead, or is not yet viable, no harm will be done, and dilatation may be favoured while bleeding is checked.

Ergot is of doubtful value, as it may do more harm than good by depressing the circulation and preventing dilatation. Quinine is less depressing, but also has less haemostatic action.

2. Haemorrhage from the Normally Situated Placenta.

Definition.—This is the escape of blood from the utero-placental vessels before or during labour, due to any cause which separates the normally placed placenta. It is often termed "**accidental haemorrhage**" as opposed to the "**unavoidable haemorrhage**" from a praevial placenta due to dilatation of the lower-uterine-segment. The term is convenient and is well understood, though, speaking very strictly, it includes bleeding from praevial placentae when separated by causes other than dilatation.

Accidental haemorrhage is a rather more frequent complication than placenta praevia, and is more common in multiparae than in primiparae. Two varieties occur clinically, for blood may escape externally, or may be internal. In the first case the haemorrhage is **apparent**, in the other it is **concealed**, the effused blood being retained between the ovum and the uterine wall, or pouring through ruptured membranes into the interior of the ovum. The source

of the blood is the bared placental site as in placenta praevia.

Causes.—In comparatively few cases has any fall, blow or injury occurred which would in itself account for separation of a healthy placenta; though in most cases the patient or her friends can recall some slight mishap to which they attribute the occurrence. The condition is found generally in patients whose health is impaired in some way, as by heart or kidney disease, anaemia, and especially previous uterine disease. In such patients a slip or strain may be the immediate cause of bleeding or may excite uterine contractions strong enough to separate a diseased placenta.

Symptoms.—Accidental haemorrhage occurs during the later months of pregnancy with increasing frequency as the date of labour is approached. There may be pains caused by uterine contraction, or these may be absent. Flow of blood from the vagina is seldom a prominent symptom; serum, however, frequently escapes. If the haemorrhage be concealed it causes pallor, collapse and exhaustion, which are marked and persistent. The patient is anxious, restless, cold, with quick feeble pulse and rapid sighing respiration. There may be marked localised pain from distension of the uterus by the effused blood, and this may sometimes be detected by abdominal palpation.

Diagnosis.—When the blood separates the membranes down to the os uteri, and escapes externally, it only remains to distinguish between accidental haemorrhage and placenta praevia. If the presenting part can be felt as distinctly as usual, and if no placenta can be detected in the lower-uterine-segment, the condition is accidental haemorrhage. It is often stated that blood escapes between the pains in this condition, the flow being checked during the pains. But in all uterine haemorrhage bleeding is checked during contraction, though escape of effused blood from the vagina may continue. The point is, therefore, of no value in diagnosis.

Very frequently there is a slight external discharge of blood, by no means proportionate to the marked symptoms of blood loss observed. This suggests at once a partially concealed haemorrhage.

When the bleeding is entirely concealed, the symptoms may be mistaken for those of syncope; but their persistence and severity should be sufficiently distinctive. The localised pain, together with symptoms of internal bleeding, may suggest rupture of the uterus; but this does not occur until labour is advanced and the lower-uterine-segment is thinned by prolonged retraction. Extreme violence might cause rupture of the uterus in pregnancy with internal haemorrhage, which would be difficult to diagnose without the history of a serious accident. Accidental haemorrhage occurs usually before the membranes are ruptured, and causes increase in the size of the uterus without altering the presentation. Rupture of the uterus does not occur, as a rule, until after the rupture of the membranes is followed by decrease in the size of the uterus, and by some change of presentation.

Prognosis.—This is always grave, but depends upon the quantity of blood lost before treatment begins. The external form is not nearly so serious as the concealed, for the escape of blood gives an early alarm, and immediate treatment is often successful. The concealed variety is often fatal before the patient is seen. The mother is said to die in almost half of these cases, and only about 6 per cent. of the children survive. The risks to mother and child are of the same nature as those in placenta praevia.

Treatment.—If the bleeding is very slight, palliative treatment may be used with the same conditions as in placenta praevia. At the first recurrence, or if bleeding is at all profuse or persistent, a finger should be passed through the os internum, and as soon as accidental haemorrhage is diagnosed.

The **Membranes should be ruptured.** This allows escape

of the liquor amnii, and the placenta is compressed between the foetus and the uterine wall. A firm binder should be applied and the patient should then be carefully watched. If the bleeding ceases after rupture of the membranes, labour may be allowed to follow naturally. Dilatation will be slow in the absence of liquor amnii, so that the use of hydrostatic dilators may be called for.

If bleeding continues after the membranes have been ruptured, the uterus must be emptied as quickly as possible.

Dilatation must be produced by the fingers or by hydrostatic dilators, preceded, if necessary, by Hegar's dilators. As the membranes are usually ruptured as soon as the condition is diagnosed, bipolar version cannot, as a rule, be performed. **Internal Version** should be done as soon as possible, for this removes from the uterus a large part of the body of the child, and the uterus being thoroughly compressed from above, retraction of its wall checks the haemorrhage. Rapid extraction by forceps is more favourable to the life of the child. If necessary, the cervix may be incised in order to hasten delivery.

Great care is necessary during the third stage. The placenta should be removed at once, and the fundus should be firmly compressed for some time. For treatment after accidental haemorrhage, see post-partum haemorrhage.

When there is little or no dilatation of the cervix, **abdominal section** is the proper treatment, and would save many lives if done promptly, before wasting time in attempting delivery *per vias naturales.*

Plugging of the vagina must be carefully **avoided** in accidental haemorrhage. The site of bleeding is too high up to be affected by this kind of pressure, and its only result is to convert external into concealed haemorrhage.

As in placenta praevia, **ergot** is of but doubtful value, and if given in sufficient quantities to meet the requirements of such serious haemorrhage, has a very depressing effect on the heart of the already exhausted patient.

Douching with very hot water is, of course, advantageous at all stages by promoting uterine contraction, but not a moment should be spent in this way which could be employed in actual dilatation of the cervix or extraction of the child or placenta. This applies equally to placenta praevia.

We now summarise the leading features and ordinary treatment of bleeding before delivery.

Placenta Praevia.	**Accidental Haemorrhage.**
Placenta partly **below** retraction ring. Bleeding external, and caused by dilatation.	Placenta entirely **above** retraction ring. Bleeding external or internal, and caused by accident, exertion, placental disease, or irregular uterine contraction.
Diagnosed by bleeding and collapse, with placenta over or near os.	Diagnosed by bleeding and collapse, or by collapse with distended and painful uterus. No placenta near os.
Treated by **Plugging Vagina**, preserving membranes intact, and dilating until	Treated by **Rupturing membranes.** No plugging of vagina, but dilatation until
Bipolar version can be performed, when membranes are ruptured and a leg pulled down, followed by further dilatation and slow delivery.	**Internal version** can be performed, and a leg pulled down, after which a little further dilatation will allow of delivery. Forceps may be applied if turning is difficult.

In both conditions the third stage should be rapidly completed, post-partum haemorrhage carefully avoided, and the patient suitably treated for the after-effects of haemorrhage.

II.—HAEMORRHAGE DURING THE THIRD STAGE.

In normal labour, bleeding does not occur till the third stage has begun; and, when the uterus is left entirely to itself, the blood lost during the separation and expulsion

of the placenta amounts to about 12 ounces. When the uterus is rubbed, kneaded and compressed, the blood loss is considerably lessened. If the third stage is prolonged from any reason an undue quantity of blood may be lost, constituting haemorrhage during the third stage. We must therefore now consider the circumstances under which this occurs, and it is convenient to do so under the two headings "Retained Placenta" and "Adherent Placenta."

1. Retained Placenta.

Excluding those cases where the placenta is expelled from the uterus and remains for an indefinite time lying in the vagina, there are numerous cases in which the placenta is retained for a considerable time in the body of the uterus, not on account of abnormal firmness of its attachment, but because of the inability of the uterus to separate and expel it. These cases we define as "Retained Placenta."

The **causes** of this condition are inertia of the whole uterus, or partial contraction, which is, of course, equivalent to partial inertia of the uterus.

Atony or inertia of the whole uterus may be due to constitutional condition, and may have been present throughout labour. It may be due to exhaustion of the uterine muscle through prolongation of the first or of the second stage, which should have been avoided by timely assistance. Or it may be due to over rapid emptying of the uterus when in a state of inaction, which should also have been avoided by allowing time for retraction to take place, and by compressing the uterus from above while extracting the child by forceps or turning. The uterine muscle needs a period of rest after the supreme effort by which the foetus is expelled, and it similarly remains inactive for a few minutes after artificial evacuation. If, however, pains do not return, and relaxation persists for more than a few minutes, atony or inertia of the uterus is recognised. The

uterus may gradually fill with blood, which may escape in a constant stream or in gushes. Active rubbing and kneading of the uterus is the proper treatment for this condition. Ergot may perhaps be used in general atony; but many authorities prefer not to use it at all till after the birth of the placenta. If the liquid extract be used, ʒii should be given by the mouth, but it is better to inject 3 grains of ergotine deep into the gluteal muscles. The uterus being firmly grasped with both hands, the patient lying on her back, strong pressure should now be exerted in the axis of the brim. If this fails to expel the placenta from the uterus it is probable that some actual adhesion exists. A clean hand should therefore be passed into the uterus, and while the fundus is depressed from above the pubes, the placenta should be separated and removed.

Partial inertia of the uterus may be due to the same causes as the preceding condition. Spasmodic contraction in some part of the uterus is most frequently due to the use of ergot during labour, but may also be set up by irritation in neighbouring organs, and by placental adhesions. **Hour-glass contraction** is a well-known form of this condition. It is often stated that the constriction which grips the placenta is at the internal os. In reality it is the retraction ring which forms the narrow orifice through which the placenta is unable to escape. The lower-uterine-segment and cervix remain flabby and relaxed. The placenta distends the retracting body of the uterus, and the lower margin of the retracting part firmly grips the lower part of the placenta. Occasionally a partial contraction of the body may encyst a portion of the placenta. Again the cervix and lower-uterine-segment may lose their passivity and close up sooner than is usual. The so-called polarity of the uterus must be remembered in this connection. This term implies that when the body of the uterus is in contraction the cervical muscle is relaxed, and *vice versa*, just as in bladder and rectum the sphincter relaxes normally

only when the muscular wall of the organ is in a state of contraction. Thus during the third stage, as at other times, inertia of the body of the uterus may be accompanied by spasm of the cervix, and in this case considerable haemorrhage may occur. In these spasmodic conditions ergot must be carefully avoided, being indeed their commonest cause. Chloroform should be administered at once to produce its full physiological effect, and then, one hand on the fundus and the other in the uterus, the contraction should be overcome and the placenta removed. An opiate may then be administered.

2. Adherent Placenta.

Organic adhesions of the placenta vary in degree. A thin and widely extended, but otherwise healthy placenta, may fail to separate completely in spite of an active uterus. True adhesions are due to disease of the placenta or of the decidua, causing imperfect development of the spongy layer through which separation should take place. The spaces in this layer are not so large or so numerous as usual, their epithelial lining is destroyed, and the septa between them are more tough and fibrous than in normal specimens. True adhesions of this kind are comparatively rare. Thus the medical officers of maternity hospitals are very frequently summoned to remove a so-called adherent placenta which is lying in the vagina, or which is merely retained in utero for want of a squeeze.

For clinical purposes Hart considers adhesions of the placenta as follows, with their treatment :—[1]

1. **Total** but **slight** adhesion, in which no separation, and consequently no bleeding occurs. After waiting a reasonable time, say ¾ hour, during which legitimate compression fails to expel the placenta, the hand is introduced and separation is easily accomplished in the proper plane, that

[1] Selected Papers, p. 179.

is, in the spongy layer. Nothing is left behind and the uterine wall is uninjured. After a hot antiseptic douche there is no further trouble.

2. **Partial adhesion**, the placenta separated below but firmly adherent above. Blood escapes freely. Retraction is hampered by the adhesion. Rubbing and kneading of the uterus fail to check the haemorrhage, and the practitioner is forced to end the third stage at once by passing a hand to the fundus and actively detaching the placenta with the finger ends, from below upwards or from above downwards, as is most convenient.

3. **Partial adhesion**, the placenta separated above, but remains attached below. The uterus retracts and prevents bleeding, but expression still fails to remove the placenta. After waiting a fair time the hand is introduced and some adhesion at the lower margin is found and separated.

4. **Total and firm** adhesion, with no bleeding, as no separation can occur. After trying expression and waiting a fair time, the hand is introduced, and it is found impossible to separate the placenta through the spongy layer. Working from the margin inwards, the fingers either leave the tips of the villi and the decidua attached, or scrape them away together with the surface of the uterine muscle. It may be impossible to remove the placenta whole, difficulty is experienced in taking it away, bit by bit. Portions of decidua left do not easily separate and come away in the lochia, but tend to remain and decay *in situ*, the uterine wall is injured, and accordingly the risk of sepsis is greatly increased. Therefore intra-uterine antiseptic douches must be used after labour and for some days during the puerperium.

III.—POST-PARTUM HAEMORRHAGE.

Bleeding from any part of the parturient canal may be included by the term post-partum haemorrhage, but we

refer here only to haemorrhage from the uterine cavity after the birth of the placenta.

Causes.—This can not occur unless uterine retraction is imperfect, and this single condition is the only one necessarily present. Persistent relaxation or imperfect retraction of the uterus is of course the same condition which has been referred to as atony or inertia, and may be due to any of the causes above mentioned (see page 347). But other conditions must be mentioned which favour post-partum haemorrhage, we therefore enumerate its causes as follows :—

1. Imperfect retraction, which is always present.

2. Certain states of the blood. Some women are said to "flood" after every labour, and are known as "bleeders."

3. Large placental site, such as that of multiple pregnancy.

4. Lateral or fundal implantation of the placenta is said to allow of bleeding more than anterior or posterior implantation.

5. Retained portions of placenta or membranes ; also blood clot.

6. Deformity of the pelvis, which prevents the uterus from sinking into the cavity so as to compress the uterine vessels.

Symptoms.—The bleeding may be continuous with that of the third stage, it may begin a few minutes after the removal of the placenta, or after a longer interval which is usually less than an hour. Blood may flow from the vagina in a continuous stream, or may escape in gushes. It may remain in the passages and distend the uterus, escaping only when squeezed out by the hand or by a cough or movement of the patient. The bed may be drenched with blood which may saturate the mattress, and even reach the floor. The patient may faint or may remain conscious, with pallor, a thin rapid pulse, quick sighing respiration, and often yawning. Cold sweats, restlessness and anxiety follow, with gasping and failure of sight. Death quickly

occurs if the haemorrhage is not checked. Recovery is marked by increased liability to septic mischief, local and general. Phlegmasia alba dolens is sometimes a sequel, and nervous complications of the puerperium are said to occur.

Diagnosis.—Bleeding from a lacerated perineum, vagina or cervix may simulate haemorrhage from the uterine cavity. After firm contraction of the uterus has been secured and is maintained, continued haemorrhage must be from one or other of these lacerations. The tendency to varicosity in the veins of the vagina and pudenda during pregnancy should not be forgotten, as it may render very serious bleeding from laceration of these structures. It is recorded that a patient bled to death from a ruptured varicose vein in the leg while the attention of the attendant was absorbed by the post-partum uterus. Uterine inertia during labour and a rapid pulse at its close are warnings that haemorrhage may occur.

Prophylactic treatment.—The possibility of post-partum haemorrhage should be remembered in every labour, and the management throughout should be such as to avoid imperfect contraction at its close. **The first stage** must be prevented from continuing too long by the judicious use of aids to dilatation. **The second stage** must not be allowed to exhaust the uterus, and must be artificially terminated when necessary; but the uterus must not be emptied rapidly by forceps or turning, and must be made to contract by keeping a hand on the fundus, and following down the retreating body of the foetus. **The third stage** is the most important. It must not be hurried, the uterus should be stimulated by judicious manipulation, and must be completely emptied. The maintenance of continuous pressure control of the uterus from the birth of the child till the birth of the placenta is the all important prophylactic measure, and if regularly practised would probably prevent 99 per cent. of the cases of post-partum haemorrhage. After the third stage ʒii of the liquid extract of ergot may be given by

the mouth, or 2 to 3 grains of ergotine may be injected into the buttock if the uterus does not contract well.

Treatment.—Nature's methods of checking haemorrhage from the uterus suggest the best artificial means of securing the same object. They may be reviewed as follows :—

1. *Retraction* of the uterus compresses all the vessels in its wall. The arteries have a spiral course through the wall; the venous sinuses have angles and bends at which their lumina are closed during contraction and retraction.

2. The walls of the torn arteries themselves *contract.*

3. *Thrombosis* occurs in the vessels and plugs their lumina.

4. The anterior and posterior walls of the uterus are in close apposition after the expulsion of the placenta, and exert *pressure* each upon the surface of the other.

5. The uterus sinks into the pelvis and is *compressed* by its bony walls, while the vessels entering and leaving the uterus are *compressed* between the uterus itself and the walls of the pelvis.

These may be compared with the artificial methods of arresting bleeding.

(*a*). **Ergot** causes contraction of the uterus itself and of the walls of the arteries (1 and 2).

(*b*). **Heat and cold** both act in the same way as ergot but much more rapidly (1 and 2).

(*c*). **Manipulation** causes contraction of the uterus, and digital compression forces the walls of the uterus against one another (1 and 4).

(*d*). **Packing the cavity** of the uterus exerts pressure on the bleeding surfaces, and also stimulates uterine contraction (1 and 4).

(*e*). **Styptics** act in a manner somewhat resembling thrombosis (3).

These are the means in general use, though others such as electric stimulation of the uterus to contraction are sometimes mentioned.

(*a*). **Ergot** does not act quickly enough for the actual

treatment of post-partum haemorrhage, its use is preventive rather than curative.

(*b*). **Manipulation.**—The uterus must be actively rubbed, grasped and compressed with both hands, the patient lying on her back. If the bleeding does not cease at once, one hand must be passed into the uterus, the other still compressing the fundus. The uterus must be quickly emptied of blood clot and any remains of placenta or membranes. The hand is then withdrawn from the uterus, the fingers are slipped behind the cervix, which is held firmly in the hollow of the hand. The external hand holding the fundus and the internal one the cervix, the uterus is now squeezed between them with all the force the operator can command. This pressure is to be continued until a hot douche is ready.

(*c*). **Heat (hot water).**—The douche must be at a temperature of 120° F., or as near it as the operator's hand can bear. The buttocks may be brought over the edge of the bed and a mackintosh arranged to direct the back-flow into a pan on the floor; or, the patient being on her back, a douche pan or an ordinary hand-bowl may be used. A Higginson's syringe best supplies the stream, which must be carried to the fundus. For this a long tube is necessary, such as Budin's uterine tube, which is grooved to allow of free back-flow. A large catheter may be used if the finger is passed beside it through the cervix. Fritsch's catheter is too small in bore and too curved for this purpose. The injection of air into the uterine cavity must be carefully avoided, and it must be remembered that, if a free back-flow is not provided, the injected fluid will distend the uterus, and some of it may even be forced through the Fallopian tubes into the peritoneal cavity. Five or six syringefuls at a time should be injected with some force, as the mechanical impact of the fluid is useful. The addition of vinegar (1 in 5) to the hot water is of great value when a second douche is needed.

We must now consider the reasons for which the use

of hot water as above described has replaced the time-honoured method of checking haemorrhage by the application of cold. It used to be customary to apply cloths wrung out of ice-water to the abdomen and vulva, to place ice in the vagina, or to inject ice-water into the uterus. It was thought that heat always increased bleeding by relaxing the walls of vessels, and this idea still exists in some minds. It is true that warmth increases bleeding, but heat (110-120° F.) checks it much more rapidly and permanently than cold.

As this use of hot water is of the widest application in surgery and therapeutics, apart from midwifery and gynaecology, we emphasise its importance by free reference to Dr Milne Murray's experiments and the conclusions he draws from them.[1] The uteri and vaginae of rabbits were arranged so that their contractions were recorded upon a revolving cylinder, and stimulus was applied by means of water at varying temperatures.

The results are summarised as follows :—

Cold.	**Heat.**
Stimulus—water at 32° *to* 60° *F.*	*Stimulus—water at* 110° *to* 120° *F.*
1. Latent period marked.	1. Latent period absent or very short.
2. Contraction slow.	2. Contraction rapid.
3. Relaxation quick, about 3 times duration of contraction.	3. Relaxation slow, 12 to 24 times duration of contraction.
4. A period of rest needed after one contraction before another can be produced.	4. No period of rest needed after one contraction before another can be produced.
Each contraction less effective than the previous one.	Each contraction more effective than the previous one, for maximum contraction and period of relaxation both increased.
In four experiments, $\frac{4}{5}$ initial efficiency lost.	In four experiments, 4 times initial efficiency gained.
5. Continuous stimulation produces rapid exhaustion, the muscle becoming completely relaxed.	5. Continuous stimulation produces a high degree of contraction with minor relaxations and contractions.

[1] Edin. Med. Journ., 1886-7, pp. 131-215.

The mesovarium of the rabbit being exposed on each side, cold water was allowed to fall on one side and hot water on the other for four minutes. Both sides soon became pale and bloodless. The vessels of the cold side began to fill again in four minutes. The membrane then became red, and then bright scarlet from hyperaemia due to reaction after stimulation by cold. The vascularity was maintained half an hour later. The hot side remained quite pale and bloodless for several minutes, and gradually returned to its normal condition without ever becoming hyperaemic.

Thus unstriped muscle in the walls of vessels behaves in the same way under stimulus by heat and cold as does unstriped muscle in the wall of the uterus. Another experiment tested the effect of heat and cold upon bleeding from a wound in the uterus of a pregnant rabbit. Water was allowed to flow over the wound at a temperature of 123° F., when the bleeding ceased at once. The temperature being gradually reduced to 100° F. the bleeding began again, and continued freely till 46° F. was reached, when it began to lessen. With the temperature at 36° F. bleeding ceased for about two minutes; but, when it recommenced, cold had lost its power to check it, for ice was applied to the wound without doing so. A little water at about 120° F. again stopped the flow completely.

Thus water at 120° F. and 10° below constricts small vessels and checks bleeding at once.

Water at 100° F. and about 40° below dilates small vessels and increases bleeding.

Water at 50° F. and below constricts small vessels and checks bleeding, but its action is temporary and is followed by a prolonged reaction, during which there is pronounced dilatation of vessels and increase of bleeding.

Dr Milne Murray goes on to point out that the advantages of hot over cold water in checking haemorrhage are as follows:—

1. *Greater rapidity* of action.

2. *Greater duration* of the contraction caused, which allows thrombosis to occur before relaxation.

3. *Absence of reaction* during which the vessels are dilated and the uterine wall relaxed.

4. *Absence of exhaustion* of contractile power. Unstriped muscle will contract time after time and more forcibly each time in response to heat, while cold rapidly exhausts the contractility of the muscle. Thus heat does not fail in continued or recurrent bleeding.

5. *Avoids abstraction of heat* from the body of the already cold and exhausted patient. Treatment by cold adds to the depression and collapse caused by the haemorrhage, while treatment by heat stimulates and warms the patient, so counteracting the effects of the haemorrhage.

There is one solitary fact in favour of cold water, namely, that water from the tap is always cold, while the water in the kettle is not always boiling. Ice, however, is more difficult to obtain than hot water. Further, it is always the duty of the accoucheur to see that plenty of hot water is ready before labour ends. If cold water is used in an emergency, hot may be used after it as soon as it can be obtained.

(*d*). **Packing the uterine cavity.**—There are few cases in which hot water fails to check post-partum haemorrhage. In these rare cases tightly packing of the cavity of the uterus with an antiseptic substance exerts pressure on the bleeding surface and stimulates contraction. Iodoform gauze is the best material for packing. Long strips should be introduced with the help of a speculum[1] and a long pair

[1] The Sims speculum is in common use, but the weighted speculum is more convenient, as it is retained in position and pulls back the perineum by its weight, and leaves both hands free. It has a broader and shorter blade than the Sims, and the handle is heavily weighted with lead. It can only be used in the dorsal posture, and is heavy to carry about, but otherwise is most useful in Obstetrics and Gynaecology.

of forceps. Several yards of gauze will be required, as the packing must be very firm and must be pushed right up to the fundus. It is the worst possible practice to plug the vagina, cervix and lower-segment alone, as a cavity is left above to be distended with blood. After twenty-four hours the packing should be removed and an antiseptic intra-uterine douche given at 120° F.

(*e*). **Styptics.**—The use of styptics in post-partum hæmorrhage has largely been given up because of its bad results. It doubtless stops bleeding, but it does so by killing the superficial tissue all over the inside of the uterus. The dead tissue has to be got rid of, and its decomposition and separation affords a favourable opportunity for septic processes. When hot water has failed, and no material suitable for packing is at hand, perchloride of iron is the best styptic to use. The Liquor Ferri Perchloridi fortior may be used (one part to four or five of water); or the salt may be dissolved in eight times its weight of water. The fluid may be injected to the fundus with an intra-uterine tube, and allowed to flow over the walls of the cavity; or swabs may be dipped in the solution and rubbed all over the uterine surface. A speculum should be used and the vaginal walls should be protected. Before the styptic is applied, the uterus should be carefully washed out with hot water to remove all clots and blood, as the presence of these would add to the amount of dead matter left to decay in the uterus. Iodine and various other substances are recommended, even vinegar being useful. Iron is, however, the only styptic that is likely to succeed after hot water has failed. To aid in the removal of the destroyed tissue, intra-uterine antiseptic douches should be freely used during the puerperium.

Secondary post-partum haemorrhage is discussed amongst complications of the puerperium.

We must next consider the treatment which is appropriate after a patient has suffered from haemorrhage. The main

objects are to provide a sufficient supply of blood to the central nervous system, and to give the heart enough fluid to contract upon.

It may be sufficient to keep the head low by removing the pillows and raising the foot of the bed. Alcohol, beef-tea and other warm fluids may be given by the mouth, and hot bottles may be placed round the patient. These are said to favour secondary bleeding if too near the pelvis. In worse cases the administration of stimulants and fluid *per rectum* is invaluable. Three ounces of fluid at 100° F. can be easily retained. Peptonised beef-tea, with ʒi or ʒii of brandy or whisky, and perhaps a little strychnine, is a good mixture for this purpose, and may be repeated at short intervals, allowing time for absorption. In cases of more immediate need, 20-40 m. of ether may be injected well into a fleshy part. When injected subcutaneously it often kills the skin over it, causing a huge ulcer. Brandy may be given in the same way with good result. Strychnine and strophanthus are also invaluable for hypodermic use.

When the quantity of blood lost is very great it is necessary to replace it in some way. We therefore briefly mention some of the ways in which this may be done.

Auto-transfusion.—This consists in driving the blood which is in the limbs of the patient into the trunk; so that what blood there is may the better fill the heart and supply the brain. It is done by raising the limbs, rubbing them from the extremities towards the body, and then bandaging them in the same direction. This manoeuvre may save the patient's life or at least afford time for more radical measures.

Saline transfusion.—This, of course, is not transfusion at all, but the introduction of a warm saline solution to the circulation. It is only useful by adding to the amount of fluid in the body; but this is what is needed in many cases. The solution should be made of water which has been sterilised by boiling, and should be given at a temperature

of 100° F. Common salt ʒi and bi-carbonate of soda ʒss to one pint of water is good, or, phosphate of soda ʒi to a pint, but common salt may be used alone. The advantage of this method is that it is very little trouble and requires no donor of human blood. It can therefore be used before very serious indications appear as a preventive of the serious effects of blood loss.

Saline solution is rapidly absorbed from the **rectum**, and by injecting it frequently in small quantities a good deal can be introduced into the circulation in the course of an hour.

A somewhat quicker method is to introduce the fluid into the **cellular tissues** by means of a needle. For this all that is necessary is a funnel, a piece of rubber tubing and a large hypodermic needle. The needle is inserted well under the skin of the back, or above the clavicle while the stream is flowing, and the funnel being elevated, gravity supplies all the force necessary. The author uses, instead of one needle, a small T-shaped tube bearing four large needles by which the fluid is introduced four times as fast as through a single one. Massage aids the distribution of the solution through the tissues, and in this way a pint of fluid can be got into the circulation in about half-an-hour. The introduction of saline solution into the peritoneal cavity has been very successful in several cases.

A still more rapid method is to open a **vein** and tie into it a canula which is connected with the funnel containing the solution by a rubber tube as before. When it is worth while to open a vein it is usually advisable to procure defibrinated human blood to mix with the saline solution, and this leads us to the next method.

Transfusion of blood.—There are numerous methods of transfusing human blood. The easiest, but the least satisfactory of these, is **mediate transfusion**. Blood is drawn from a vein in the donor's arm to the extent of 10 or 12 ounces and is gently stirred with a fork for about five

minutes. It is then filtered through muslin into a funnel, whence it flows by a rubber tube and a canula into a vein in the patient's arm. A syringe of glass is often used instead of a funnel. The blood may be mixed with saline solution, and the fluid injected should be as near blood heat as possible. More satisfactory results have been obtained by **direct transfusion** from **vein to vein**. For this many forms of apparatus have been used. All that is necessary is a short piece of elastic tubing at each end of which is a canula. One canula is introduced and tied into a vein in the donor's arm, the tube being clamped. The patient's vein is then opened, and the other canula is introduced into it after blood has been allowed to displace all air from the tube. The flow is usually allowed to continue for about 3 minutes; but the pulses of patient and donor are carefully watched so that the operation may be terminated when that of the patient is sufficiently improved or when the donor has lost enough blood. A still more perfect operation is said to be **direct arterial transfusion** from the dorsalis pedis artery of the donor to that of the patient. A simple elastic tube and two canulae are used. The arteries are divided below spring clips and the canulae are directed toward the heart. This method is more difficult than direct venous transfusion and is inconvenient for the donor, who must lie up while the wound in the foot heals.

CHAPTER XVIII.

COMPLEX LABOUR—*Continued.*

MATERNAL COMPLICATIONS—*Continued.*

Rupture of the Uterus.

Causes.—This accident is favoured by previous disease, (*e.g.* fibroid) of the uterine wall, and is more common in multiparae than in primiparae. Excessive thinning and stretching of the lower-uterine-segment leading to rupture may be produced by any cause of delay in labour other than inefficiency of the expulsive powers. Contracted pelvis, transverse presentation and hydrocephalus are perhaps the most frequent of these. Injury of the uterine wall by instruments or in turning may also cause rupture. The general frequency is about 1 in 4000 cases, in multiparae it is about 1 in 500.

Varieties and Site of Rupture. — The passive lower-uterine-segment is, as a rule, the site of rupture. The tear may spread upwards from the cervix, which, however, may not be involved. Occasionally the lesion is in the retracting portion of the uterus when this has been weakened by disease or previous Caesarian operation. The left side of the uterus is the commonest situation for the tear, which may be longitudinal, oblique, or transverse. It is usual to describe the rupture as complete when the whole thickness of the uterine wall is torn through, and incomplete or partial when only part of the thickness of the wall is involved. The important point is to know whether or not the peritoneum is torn. There is a triangular space on each side (see page 230) 5 in. high, and 3 in. wide at its base,

within which the uterus is not covered by peritoneum but is in contact with connective tissue. Thus rupture of the whole muscular wall of the uterus can easily occur without injuring the peritoneum if the tear extends into the pelvic connective. Posteriorly the peritoneum descends on to the vaginal wall, so that a tear extending through the whole muscular wall of the uterus posteriorly is almost certain to involve the peritoneum.

Course.—Premonitory symptoms are tedious labour, with marked thinning of the lower-uterine-segment. If Bandl's ring can be felt through the abdominal wall, two inches above the pubes, rupture may be said to threaten, especially if the contractions are painful and continuous. Pain may be localised to one part of the abdomen. Rupture may occur suddenly or may be gradual and imperceptible. After complete rupture the uterus becomes quiescent, and the patient feels a sense of relief after the previous violent pains; but symptoms of collapse and of haemorrhage rapidly appear. In incomplete rupture the same symptoms appear more slowly. There may be local tenderness, and blood may escape from the vagina. The presenting part may recede or change, and the foetus may escape into the peritoneal cavity. It may be possible to feel the tear *per vaginam.* If this can be done the **diagnosis** is easy, otherwise it must be arrived at from the above symptoms and signs.

Prognosis.—When the peritoneum is injured the patient may die early from shock and haemorrhage, or subsequently from peritonitis. When the peritoneum is not torn the chance of recovery is much greater. The maternal mortality is estimated at about 90 per cent., but this is lowered by the use of abdominal section.

Treatment (prophylactic).—If rupture is threatened chloroform should be given freely to minimise uterine contraction. Forceps should then be used. In transverse cases, great care should be used if turning is attempted, and decapitation should be preferred if difficulty is met with.

The cervix may be incised in several places in order to avoid loss of time in obtaining dilatation.

After rupture has occurred it is necessary to deliver the child as quickly as possible. It may be possible to do this *per vias naturales*, but if the foetus has escaped into the peritoneal cavity the only reasonable chance of success is afforded by abdominal section. This should be performed if the presenting part has altered its position, in transverse cases, and if the cervix is undilated. After the removal of the foetus by abdominal section, Porro's operation should be done, as a tear in the uterus, even if promptly stitched, will not heal up like the clean incision used in the Caesarian operation. The vagina must be repaired if torn.

If the foetus has been removed *per vias naturales* it is necessary to consider the treatment of the rupture. If the peritoneum is torn, Porro's operation should be performed. If the tear involves only muscular tissue, or extends into the connective tissue of the pelvis, the parts should be carefully douched, and the tear plugged with iodoform gauze, which will check haemorrhage by pressure, and will also provide drainage.

Tears of the Cervix.

These may be caused by the passage of the head, but are usually the result of artificial delivery before complete dilatation has been secured. They may cause considerable bleeding, and the occurrence of haemorrhage together with firm contraction of the uterus indicates the presence of some such laceration. The bleeding may be controlled by digital pressure, and the tear, if extensive, may be stitched with strong chromicised catgut at once. Absorption of septic matter by the torn surfaces is a fruitful cause of infective inflammatory pelvic disease.

Tears of the Vagina.

The upper part of the posterior vaginal wall is the thinnest and least protected part of the parturient canal.

Tears in this position sometimes occur, and usually enter the pouch of Douglas.[1]

Tears in the lower portion of the vagina may occur in any part of the wall, but they are usually posterior, and are continuous with ruptures of the perineum.

Rupture of the Perineum.

Tears may occur at the vulvar outlet, anteriorly or laterally, but these are very rare in comparison with posterior tears near the middle line, involving more or less the perineal body.

Causes.—These are precipitate labour, with violent pains, and often with delivery in the standing posture. Voluntary straining is usually checked by the pain it causes, but may produce tearing. Partial anaesthesia may abolish pain, and control, without checking, contraction, and may so favour rupture. The vulvar aperture may be directed too far forward, may be small, or may be rigid as in elderly primiparae. The sacrum may be flat, and allow the head to descend straight on to the perineum instead of directing it forward as usual. Large size of the pelvis favours precipitate labour. The kyphotic pelvis causes rupture, as do other pelves with contracted outlet. Large or firmly ossified heads may tear the perineum, and those delivered occipito-posterior are specially likely to do so. The passage of the shoulders may increase or cause a tear, also the unskilled use of forceps, or rapid extraction after turning when care is not taken to prevent extension. Almost all tears of the perineum occur in primiparae.

Varieties.—In a first labour there is always slight laceration of the hymen and fourchette. This may involve the posterior vaginal mucosa and the skin of the perineum. Further tearing involves the perineal body itself and the skin over it, and may reach the sphincters of the anus.

[1] Hart, Selected Papers, p. 99.

These are all partial tears. Complete tears go through the sphincters and mucosa of the anus, and may extend a considerable distance up the recto-vaginal septum. In central tears the child is born through the perineum, the vaginal mucosa, perineal body and skin giving way in turn; but the margin of the vulvar outlet is uninjured. It must be remembered that the subjacent tissues can be torn without apparent injury either to the skin or the vaginal mucosa.

Diagnosis.—Many practitioners who say that they never see tears of the perineum in their practice, are able to make that statement only because they never look for them. It should be a rule always to inspect the perineum after labour is over.

Prognosis.—Tears involving the anus cause incontinence of faeces. Less serious ones are often followed by prolapse of the uterus.

Treatment (prophylactic).—The prevention of laceration has been described, and consists mainly in promoting flexion and preventing extension (see pp. 266 and 284). When rupture is imminent, it is wise to release the head by making a lateral incision in each side of the vulvar outlet, sufficiently far back to avoid injury to the ducts of the glands of Bartholin. Scissors are used, and it is often possible to divide the band of tissue causing the constriction by an incision through the mucosa, without injuring the skin. A stitch or two with catgut after labour secures healing. This preserves a perfect perineum with no risk, and is much preferable to the possibility of a bad tear in the middle line.

Repair of the Perineum.—Minor tears may be left alone; but those which extend to within $\frac{3}{4}$ inch of the anus should be stitched. A continuous suture of medium chromicised catgut may be used, with one of the curved needles of Martin or Hagedorn, and a needle-holder. The deeper tissues should be first drawn together, and then the super-

ficial parts, the deeper stitches being buried. The suture need not pass through the skin. Retention of urine may often be avoided by leaving the stitches rather loose, and is said not to occur if the skin is not sutured (Hart). Use of the catheter may be necessary for a day or two. After-treatment consists in keeping the parts clean. Some prefer interrupted sutures, and some use silver wire or silkworm gut, the disadvantage of these being that they need removal on a subsequent occasion, while catgut lasts quite long enough to secure healing, and is then absorbed. If the sphincter is torn, special care must be used in bringing its ends firmly together. If the rectal mucosa is torn, it should be united by a few interrupted catgut sutures, passed from the rectum and back into the rectum, so that the knot when tied lies in the rectum. The anal canal being thus first repaired, the continuous suture may be used for the sphincter and perineal body. The stitching should be done as soon as possible. It is not likely that union will occur if it is deferred for more than twelve hours, but the operation may be successful even twenty-four hours after the injury. If union does not occur at once, the raw surfaces must be allowed to heal, and the condition must be cured by a plastic operation at a later date, say after two months have elapsed.

Laceration of the Bladder.

Injury to the bladder is but rarely noted at the time of labour, and is rarely caused by the use of instruments. Prolonged pressure of the head through delay in using forceps frequently causes subsequent sloughing of part of the wall of the bladder, which has been squeezed between the head and the pubes. Lacerations caused and seen during labour should be stitched at once. Vesico-vaginal fistula following sloughing must be closed by operation after the raw surfaces have healed.

Haematoma.

Effusion of blood during labour into the connective tissue of the pelvis has been mentioned as a cause of delay in the second stage of labour. It may also occur after labour. A bluish swelling of varied size may form at the vulva or within the vagina, and the blood may spread up into the false pelvis and abdomen along all the planes of separation between the various portions of the pelvic connective tissue. The swellings should not be incised during labour till clotting has occurred, lest free haemorrhage should follow. The effused blood is usually absorbed gradually. Suppuration may occur, causing the puerperium to be complicated by pelvic abscess.

Inversion of the Uterus.

This is a turning outside in of the uterus, partial or complete. It is now excessively rare, but was more frequent when it was usual to remove the placenta by pulling on the cord. It may occur spontaneously in atony of the uterus, and when one part of the wall is active, another being passive. The active part grasps the passive part, invaginates it and depresses it like a foreign body. The presence of a fibroid is apt to cause this occurrence. The placental site is usually the first invaginated portion, especially when it is fundal. Inversion may occur during or after the third stage.

There are two mechanisms, as the invagination may be from above downwards, the fundus being drawn down into the body, or from below upwards, the retracted portion of the uterus being driven down into the relaxed lower-uterine-segment and cervix, which are first turned inside out.

The symptoms are expulsive pains, pressure on bladder and rectum, haemorrhage and shock. The palpating hand above the pubes misses the fundus, which is found in the

vagina, or may protrude from the vulva, prolapse being added to inversion.

If the placenta is adherent, it must be stripped off at once, and a douche of hot water should be given to aid contraction and check bleeding. The inversion should then be reduced immediately. An anaesthetic affords great assistance. One hand should apply counter pressure above the pubes, while one hand in the vagina pushes up the fundus, following the mechanism by which it descended, *i.e.*, beginning at the cervix or at the fundus. Some recommend beginning at one corner by pressing in the origin of one Fallopian tube.

If the inversion is not diagnosed at the time of its occurrence it may kill from shock and haemorrhage in less than an hour, or may spare the life of the patient but cause haemorrhage and yellow discharge. 28 per cent. are said to die soon and 42 per cent. ultimately of the accident. Toleration of the condition may be more or less established, and years may pass with the uterus inverted, but causing no urgent symptoms. The diagnosis in the chronic condition demands careful examination and the use of the sound. Prolonged pressure may reduce the inversion after it has been present some time, but it is usually necessary to amputate the uterus. Various instruments have been devised for applying prolonged elastic pressure to the inverted uterus.

Diseases of Circulatory System.

Valvular Lesions.—In discussing heart disease during pregnancy (page 115) we have noted the relative seriousness of the various lesions, and seen that stenosis of the mitral valve is that most likely to cause trouble, because it is the lesion which specially tends to overload the pulmonary circulation and cause dilatation of the right heart. Aortic stenosis has a similar result. During labour the patient

must be prevented from exercising the accessory powers by voluntary straining; thus she must not be allowed to hold her breath and bear down, and should not have fixed points to pull and push against, as these enable her to exert herself injuriously. The action of strophanthus or of digitalis should be kept up during labour. The first stage must be completed, and then delivery should be aided with the forceps without waiting. Chloroform is most useful in preventing straining and exertion on the part of the patient, and those with heart disease need it more than others. Heart disease in labour is no contra-indication for chloroform.

Hart has pointed out that the dangerous time in these cases is the third stage.[1] During pregnancy there is an increase, both in the quantity of blood in the body and in the size of the circulatory system. At the end of labour the size of the circulatory system is suddenly reduced by the retraction of the uterine muscle, which practically obliterates the uterine and placental sinuses. But if there is not free haemorrhage there is no corresponding reduction of the quantity of blood in the body. The extra blood is thrown into the venous circulation and passes to the right side of the heart. But if this is dilated and weakened, the lungs being engorged, and passage of the blood through the left heart being checked by mitral or aortic stenosis, the extra blood entering the right heart may distend it, paralyse it, and cause the immediate death of the patient at the end of the third stage. Incompetence of the valves does not cause trouble in this way, for though backward pressure is caused, there is a free outlet for blood to the front, and an extra amount of blood thrown into the circulation more readily becomes distributed. The state of the right heart is estimated by venous pulsation in the neck, engorgement of the lungs, liver and abdominal viscera, dilatation as

[1] Selected Papers, p. 182. See also Angus Macdonald, Heart Disease in Pregnancy and Parturition.

discovered by percussion, and the character of the sounds, weakness of the first sound being a specially unfavourable indication. Fresh endocarditis set up during pregnancy may render the condition still worse. Free bleeding at separation of the placenta is a most favourable occurrence when these signs are present, as it removes the excess of blood from the circulation. The treatment of the third stage should accordingly be as follows. Avoid the use of ergot, allow free haemorrhage, and if it does not occur, encourage it with a warm douche (not hot). At the onset of dyspnoea or irregularity of the pulse, inject strophanthin and strychnine, and apply a dry cupping glass over the heart. If symptoms of embarrassed circulation persist, bleed freely from the arm by venesection. Keep a careful watch on the patient for a day or two.

Embolism.—Embolism of the pulmonary arteries may occur during labour as well as during the puerperium, and is a frequent cause of sudden death during either period. The source of the clot is thrombosis in the pelvic veins. Sudden death during labour may sometimes be averted by venesection, and the prompt injection of ether and other stimulants. Ammonia is said to be very useful.

Embolism of systemic arteries is less common during labour, and has no result calling for treatment before labour is over, though cerebral embolism may cause immediate death. The left heart is the usual source of the clot.

Air may enter the veins during labour, if it is admitted to a relaxed uterus. It may cause death by obstructing the passage of blood through the right heart.

Syncope.—In various forms of heart disease, affecting the valves, muscle or nerve supply, death may occur from gradual or sudden failure of the heart, apart from any obstruction to the circulation. In these cases death may often be averted, the treatment being stimulation in various forms, such as warmth, ether, brandy, sinapisms, strychnine,

digitalin, strophanthin, nitrite of amyl, ammonia and electricity.

Sudden death from rupture of aneurism, from cerebral haemorrhage and other accidents precipitated by labour may also occur.

Diseases of the Respiratory System.

In respiratory disease, labour increases dyspnoea and may produce haemoptysis or various forms of emphysema. Straining in the second stage should therefore be prevented, and artificial aid should not be withheld after dilatation is complete. The general rules for treatment are—

1. Avoid fatigue and obviate distress.
2. Prevent voluntary effort, giving chloroform if necessary.
3. If the symptoms are urgent, dilate with the fingers or hydrostatic dilators, and deliver early by forceps or turning.
4. Do not empty the uterus suddenly. If alone apply a binder, and tighten it gradually as the foetus is withdrawn; but, if possible, have the fundus compressed by a competent assistant.
5. If the heart is dilated, encourage bleeding in the third stage.

Eclampsia.

This complication of labour is also called "**puerperal convulsions**," which is a bad name, because the condition occurs before and during labour, as well as during the puerperium. An eclamptic seizure is a convulsive attack closely resembling an epileptic fit, but without a cry. There may be no premonitory symptoms; or headache, nausea and affections of the eyes may occur. The face becomes pale and contorted, the muscles are rigid, and a short tonic stage, with arrested respiration, is followed by clonic contractions, beginning with twitching of the face and spread-

ing rapidly to the head, neck, and limbs. The face becomes livid, foam comes from the mouth, and is often blood-stained from biting of the tongue. The tonic stage may be omitted, or the seizure may be slight, recalling the transitory oblivion and fixed face of a minor epileptic fit. Insensibility is complete during a well-marked attack, which lasts a minute or two. The pupils do not react to light. As the fit passes off the patient is comatose for a time, with stertorous breathing. Sensibility may return in some degree before the next fit; but coma more or less deep may persist through a series of convulsive seizures, which may occur in dozens, following one another in rapid succession. Convulsions may be initiated by stimulation such as vaginal examination, or by labour pains. When they occur in the seventh, eighth, or ninth month, they frequently cause the onset of labour. The foetus often perishes through prolonged stoppage of the mother's respiration and through tetanic contractions of the uterus. The maternal pulse is rapid, and the temperature may rise. A large quantity of albumen is found in the urine in the great majority of cases. The excretion of urea is diminished, and the urine may be almost suppressed.

Frequency.—Eclampsia occurs once in about 500 cases. It is much commoner in primiparae than in multiparae, in whom it is usually associated with pre-existing renal disease. About 60 per cent. of the cases begin during labour, 20 per cent. before labour, and 20 per cent. during the puerperium.

Cause.[1]—The changes found P.M. are congestion and

[1] The Traube-Rosenstein theory of Eclampsia is founded upon the watery quality and increased quantity of the blood during pregnancy, which is said to produce increased blood pressure, and so to cause oedema of the brain. This in turn is said to cause anaemia of the brain, and so to cause convulsions. This is a complicated way of confessing ignorance of the cause. It affords no information, and is founded on no facts.

Halbertsma's theory of pressure on the ureters by the pregnant

inflammatory conditions in various stages in the kidneys; old kidney disease; dilatation of the ureters; fat embolism of the glomeruli (Virchow); alterations in heart and liver; congestion and small blood extravasations in the brain.

After the discovery that albumen is present in the urine of most eclamptic patients, it was thought that defective renal action caused the convulsions by allowing retention in the system of toxic substances which should be excreted. The nature of the poison thus retained has been debated, and urea, carbonate of ammonia, creatin, creatinin, acid phosphate of potassium, toxic products of the liver, and other substances have been mentioned. Whether one or any of these are really to blame remains still quite unknown.

It has been suggested that the kidney condition is caused by the convulsions; but this cannot be so, for albuminuria is usually present before the convulsions begin.

But it must be determined whether the renal inflammation is the primary condition, the convulsions being secondary to and caused by it; or whether both nephritis and convulsions are due to a common cause. The latter view is gaining ground at present. The reason for this change of belief is the very frequent occurrence of defective renal action without convulsions. The alleged causes of renal inefficiency in pregnancy have been mentioned above (see pp. 118 and 119). Some are accidental, others depend directly or indirectly upon pregnancy, and all have been brought forward as causes of eclampsia. Were they capable of producing it, this terrible disease would be much more frequent than it is, nay, it would be an almost normal feature of pregnancy. Another reason for believing that

uterus merely suggests one cause of impairment of renal function during pregnancy, and thus does not rank as a separate theory of the causation of Eclampsia.

Angus Macdonald attributed the condition to inflammatory changes near the vaso-motor centre causing spasm of blood vessels in the brain and in the kidneys. It is equally difficult to prove and to refute a theory such as this.

the convulsions are not caused by renal inadequacy is the fact that eclampsia very seldom recurs in subsequent pregnancies.

Thus very little is really known about the causation of eclampsia. All we can say is that the disease is due to a poison circulating in the blood, under certain circumstances connected with pregnancy, and that this poison causes convulsions and coma on the one hand, and nephritis on the other. The nature and origin of the toxic substance remain unknown.[1]

It is important to remember that, in the irritable condition of the nervous system characteristic of pregnancy, any cause of convulsions will produce them more readily than under other circumstances (*e.g.*, epilepsy, chorea).

Diagnosis. — Albuminuria does not invariably occur before the convulsions. Its presence, however, helps to distinguish this from other conditions. Hysterical convulsive attacks must be recognised by their usual characteristics. Epileptic fits are initiated by a cry, and the patient is usually known to be subject to them. Cerebral lesions, such as haemorrhage, generally cause some paraplegia as well as convulsive movements. Spasmodic movements of the body may be due simply to the stress of labour, these oftenest occur near the end of the second stage. It may be possible to distinguish true uraemic convulsions caused by renal disease known to exist, and such a distinction would modify the treatment used.

Clinical types.

1. The common form, which is classical eclampsia, is inaugurated by headache, vomiting and eye symptoms. The urine contains copious albumen and tube casts, and may turn solid on boiling. The fits are severe and

[1] A micro-organismal origin has been suggested, but it is difficult to imagine an organism whose period of pathogenic activity is confined within the limits of pregnancy and the puerperium. The theory is probably a part of the general germ-mania of the present *fin de siecle*.

obviously genuine. If labour is successfully ended the patient usually recovers completely, and has no recurrence in future pregnancies.

2. The fits may occur suddenly without any warning, except perhaps an attack of vomiting. The urine, previously normal, becomes scanty, blood-stained, and albuminous, after the fits have begun.

3. Sudden coma may occur, with copious albumen and tube casts in the urine, but no other marked premonitory symptoms. This form of attack is usually during the puerperium, and is very fatal, the coma passing into death without any return of consciousness.

4. Some patients have highly albuminous urine and anasarca to such an extent that the body pits on pressure all over. These, as a rule, do not have fits, but are delivered at full term and make good recoveries. It seems doubtful if the condition is, strictly speaking, eclamptic, but in general, it may be stated that the more marked is anasarca the less severe and frequent are the fits.

Prognosis.—This is grave but varied. It is stated that 26 per cent. is the maternal mortality; but the condition often yields to treatment, and there is but little tendency to recurrence, except in cases of chronic kidney disease. The different types vary in graveness as above indicated, and the prognosis also varies with the period of onset. Thus the majority of fatal cases begin relatively early in pregnancy, say at the seventh month, or else during the puerperium. Attacks beginning near full time usually bring on labour, after which the fits cease, or only one or two occur. The albumen disappears in three or four days, though the urine may have been solid or boiling before labour. The least dangerous cases are those in which only a few fits occur during labour at term. Insensibility between the fits, severity and frequency of the attacks render the prognosis more grave. When over twenty fits have occurred, there is but slight chance of saving the patient. Death is

caused from exhaustion by the convulsions, from the continued presence of the poison in the system, and sometimes from cerebral haemorrhage. About half the children are lost. Sepsis and other troubles are said to be frequent during the puerperium.

Treatment.—Prophylactic measures have been suggested (page 119). The actual treatment of a seizure consists in loosening the dress, providing fresh air, preventing self-injury, and administering chloroform. A cork or a piece of india-rubber should be inserted between the teeth to preserve the tongue from injury. The patient should be got to bed as soon as possible. The treatment must now be conducted with three main objects: 1. The diminution in frequency and severity of the fits. 2. The removal from the system of the poison causing them. 3. The emptying of the uterus if the condition is at all severe.

1. The seizures are best controlled by **chloroform**, which should be given freely to begin with, and again every time convulsions occur. The administration may be kept up for many hours. Chloral and bromide of potassium are also of service, and gr. xx to xxx of each may be given in a ℥iii enema. **Morphia** is now being used freely in eclampsia, and gr. $\frac{1}{3}$ or $\frac{1}{2}$ may be injected after the first fit, the dose being repeated after a suitable interval. If chronic kidney disease is present morphia will not be used. These drugs modify the fits without aiding the removal of the toxin, but **venesection**, which used to be the routine practice, does so partly by removing some of the poison from the system and partly by lowering arterial pressure. It is said by some that after blood-letting the vessels fill again in five or six hours, after which the fits recommence; but others state that by withdrawing ℥x or so of blood, the next fit may be postponed for a fortnight, when the measure may be repeated, pregnancy being thus carried on toward full time. When labour has begun, venesection will often postpone the fits till it can be terminated.

2. The function of the kidneys being impaired by the disease, removal of toxins from the system must be accomplished by the bowels and the skin. A hydragogue purgative may be given by the mouth if the patient is able to swallow. Otherwise, a drop or two of croton oil may be placed on the back of the tongue. This is always done, but it seldom seems to produce any effect. Pilocarpine may be injected ($\frac{1}{6}$ to $\frac{1}{4}$ grain). The **steam bath** is invaluable, and can be used without interfering with other measures. A cage and mackintosh sheeting to surround the patient, with a lamp and kettle to produce steam, is the best appliance. If this is not available, the patient may be surrounded with hot water bottles wrapped in wet cloths. This will produce profuse perspiration, but great care must be taken to avoid burning the skin of the unconscious patient.

3. If **labour** has commenced, the operator will aid nature and empty the uterus as quickly as possible. But if there is no sign of the onset of labour, the question arises as to whether it should be **induced or not.**

This point must be decided by (1) the severity of the fits; (2) the degree of insensibility and the length of time between the fits; and (3) the result of treatment.

Cases commencing before labour are the most dangerous, therefore no attempt should be made to prolong pregnancy in order to deliver a viable child except in mild attacks. If it is decided to induce labour, no time should be spent in the use of glycerine or bougies, but the os should be opened with solid dilators; dilatation should be continued with hydrostatic dilators, and completed with the fingers. Extraction by forceps or turning completes the operation. Chloroform should be used freely during all manipulations, as, otherwise, these may set up convulsions which greatly exhaust the patient, and may prevent a successful result. As the renal function is impaired, care should be used in the choice of antiseptics. Mercury

should be avoided. Carbolic acid must be used with care. Permanganate of potash and creolin are the safest antiseptics here.

Having reviewed the methods of treatment arranged according to their aims, we may summarise them in another arrangement :—

1. *In albuminuric patients when convulsions are threatened.*

   Chloral and bromides ; purgatives ; pilocarpine ; prolonged hot baths : diuretics and milk diet.

2. *Fits without onset of labour.*

   Chloroform ; morphia ; venesection ; steam bath or hot bottles (croton oil, chloral, bromides, and pilocarpine). Induction of labour if necessary.

3. *Fits during labour or causing labour.*

   The same methods as in 2, but terminate labour without delay.

4. *Fits after labour is over.*

   Chloroform, bromides, chloral, morphia, and steam baths are the most useful. Drugs to stimulate skin and bowels if necessary.

CHAPTER XIX.

COMPLEX LABOUR—*Continued.*

FOETAL COMPLICATIONS.

Prolapse of the Cord.

This accident occurs once in about 150 cases, and is very much more common in multiparae than in primiparae. If the funis is felt through the membranes before their rupture, the term "funic presentation" is used, if it descends after dilation when the membranes are already ruptured, the condition is called "funic prolapse."

Causes.—These may be enumerated as undue relaxation of the cervix and lower-uterine-segment, large quantity of liquor amnii, sudden escape of liquor amnii, malformed pelvis, malpresentations, small head, small child, premature or dead child, abnormally long cord, low insertion of the cord into the placenta, or of the placenta on the uterine wall.

Diagnosis.—The cord should be easily distinguished from a hand or a foot, and it should be noted whether pulsation is present in it or not.

Prognosis.—Prolapse of the cord occurs together with, and is caused by other circumstances which increase the risk to the mother, though, in itself, it adds no danger to her condition. She may suffer from interference in favour of the child, which is exposed to considerable risk from the moment when the membranes rupture. About $\frac{1}{3}$ of the

children are lost (some say $\frac{1}{2}$), the cause of death usually being compression of the cord.

Treatment.—Posturing is valuable, as in the genu-pectoral position, or another suggested by the circumstances of the case, the prolapsed cord can often be pushed up above the presenting part and retained there.

If attempts to replace the cord fail **before rupture** of the membranes, bipolar version affords the best chance of saving the child.

After the rupture of the membranes, efforts to replace the cord may be made with the fingers, with a sponge, or with various instruments constructed for the purpose. A strip of whalebone with a notch in one end in which to catch the cord is often useful. By pushing a bend of string in at the eyelet of a catheter, and then passing the tip of the stylet through the bend, a loop of string so fixed to the tip of the catheter may be made round the prolapsed cord, which can thus be replaced as conveniently as with more elaborate instruments. If it is not possible to secure re-position, the cord should be caused to lie in the least occupied sacro-iliac space. The pulsation in it should then be watched, and, if it fail, delivery should be completed as soon as possible with the aid of forceps or otherwise.

Plural Births.

The **nature** and **varieties** of multiple pregnancy have been discussed above (page 90). We have now to consider the peculiarities of labour as complicated by the presence of more than one foetus.

Diagnosis.—During labour, as during pregnancy, twins may be diagnosed by abdominal palpation and auscultation under favourable circumstances. Through the dilating os two bags of membranes may be felt, or parts of two children. These foetal parts, it will be noted, are small compared with the large size of the uterine tumour, whose appearance may

suggest hydramnios. The presence of a second foetus is, however, often only recognised after the birth of the first.

Prognosis.—The mortality of twin children is about one in twenty, and is about five times as great as that of ordinary children. To the mother the risk is increased, for the following reasons. There is often delay in the first stage due to over-distension of the uterus, hydramnios often adding to the expansion caused by the presence of twins. Premature labour is frequent. An extra strain is thrown upon the kidneys. The large placental site tends to cause difficulty in the third stage and post-partum haemorrhage, while it also favours the occurrence of septic absorption during the puerperium. Interference on behalf of the children may expose the mother to additional risk.

Owing to the small size of the children there may be no delay in the second stage. If they present differently, the one whose head presents is usually born first. The uterus then rests for a while, but the second child usually follows after about half an hour.

Management.—After the birth of the first child the cord must be tied in two places, and cut between them, lest, by communication between the placental systems, the second child should bleed to death. The uterus should be rubbed and kneaded gently to favour retraction. If the second child is transverse it should be turned at once. If an hour elapse without the birth of the second, it should be removed by forceps, or turning after rupturing the membranes, but many circumstances may call for its delivery much sooner. Both placentae may follow the first child, one may be separated and expelled after each child, or both may remain attached till after the birth of the second child. They should be examined with unusual care to secure complete emptying of the uterus. Extra precautions against haemorrhage should be used, and the possible presence of a third child must be remembered.

If difficulty is caused by the presence in the dilating os

of two bags of waters, the membranes of the leading child should be ruptured after waiting till dilatation is complete. If one foetus present the breech and one the head, the latter must be considered to lead.

Locked Twins.—If the head of the second child enter the pelvis together with part of the body of the first, the birth of the second head should be attempted, as the second child is in such cases the more likely to survive.

When a head and a breech present, and the breech descends first, the heads may become locked so as to prevent the birth of either. The first child perishes, being a pelvic presentation, so attention should be directed to the birth of the head-first child. This may be accomplished by pushing upward and unlocking the chins, or by applying the forceps to the head-first child. If this is not successful, the first or breech child must be sacrificed by decapitation. Its body being removed, the second child must be extracted, and, lastly, the head of the first child.

Double Monsters.

Acardiac Monster.—When one of twins, by overpowering the circulation of the other, turns it into an acardiac monster (see page 99), there is seldom any difficulty at labour, as the monster usually presents by the feet and is removed easily.

Conjoined Twins.—Of these Playfair mentions four main varieties :—

(1) Two bodies united more or less, anteriorly.
(2) Two bodies united more or less, posteriorly.
(3) Dicephalous monsters, with single body and two heads.
(4) Two bodies, the heads more or less united.

Out of thirty-one cases Playfair [1] found that twenty labours ended naturally, and that labour was recorded as fatal to the mother in only one case. In all of these, pelvic presen-

[1] Obstet. Trans., 1867, vol. viii. p. 300.

tations seem to be the most favourable, and turning has given good results. To deliver a bicephalous monster one head must usually be cut off. When two heads are fused, perforation seems indicated.

Apnoea Neonatorum.

Causes.—This condition, also called "asphyxia neonatorum" and "still birth," is due to numerous causes interfering with the placental or the foetal circulation, or directly injuring the head and neck of the foetus. They may be enumerated as Placenta Praevia and accidental haemorrhage, Eclampsia, heart or lung disease, death of the mother, compression of cord or placenta, compression of the head by pelvis or forceps, injury to the neck in head-last delivery. Some cases are due to mechanical blocking of the respiratory passages after birth.

Symptoms.—When the aeration of the foetal blood begins to be impaired, respiratory efforts are prematurely induced, with the result that mucus, meconium or blood is sucked into the passages. The foetal pulse rate is slowed, and paralysis of the respiratory and cardiac centres follows. The pulse becomes quick but feeble for a time before death follows, and the attempts at respiration cease. Slowing of the foetal pulse-rate and the spasms of the body seen in breech cases are thus signs of commencing asphyxia. Subsequent acceleration of the pulse and cessation of respiratory efforts indicate that the child is *in extremis*.

When born, the child may appear congested and livid, the action of the heart being slow but strong, and the muscular tonicity not entirely lost. In these cases occasional spasmodic attempts at inspiration occur, and the child is almost sure to recover. This condition is often called *asphyxia livida*, in distinction from the more pronounced form, which is termed *asphyxia pallida*. In the latter condition the child is pale, with rapid, feeble heart and flaccid muscles; it often makes no attempt to breathe.

Prognosis.—So long as the heart beats, however feebly, there is a chance of saving the child. A single spontaneous gasp usually indicates that treatment will be successful, and many lives are saved after continuing artificial respiration for upwards of an hour. In all cases of delayed, operative, or complicated labour, preparations should be made for resuscitation if necessary.

Treatment.—If the child, when born, does not breathe at once, its skin should be stimulated by friction, slapping, sprinkling with cold or hot water, or both in turn. The mouth must be cleared with the finger, while mucus or blood should be carefully removed from the throat. If the face is cyanosed and the pulse strong, it may be useful to divide the cord and allow a little blood to escape; but if the child is pale, the necessary manipulations should be carried on before tying the cord, so as to save all the blood.

Baths.—Hot baths (100° F. to 108° F.) may be used alone or alternately with cold baths (50°-60° F.). It is important, however, to keep up the heat of the body, and it is probably better to place the child in a hot bath, lifting it out from time to time and dashing cold water on its chest, than to place it bodily first in hot and then in cold water.

Artificial Respiration.—This must be begun as soon as it is seen that breathing does not follow cutaneous stimulation. The methods are numerous. Silvester's consists in placing the child on its back, the head raised, the feet fixed, and the tongue drawn forward, drawing the arms up beside the head to fill the chest, and then lowering them and pressing them firmly against the chest to empty it. Howard relies on compression for expiration, and on the elastic recoil of the chest wall for inspiration. Schultze's well-known method is to seize the child from behind, with the forefingers in the axillae, the other fingers on its back, and the thumbs in front of its shoulders, the head being held between the hypothenar eminences. The child is then

gently raised until it is inverted and flexed completely, its legs hanging down in front of the operator or over his shoulder. It is then lowered till it hangs fully extended in its previous position, and the movement is repeated eight or ten times a minute. This method is most effective, and can be continued an hour or more if necessary. Dr R. C. Buist[1] objects to Schultze's method as a dirty and inconvenient one for the operator, and a dangerous one for the child. The accidents recorded during its use are haemorrhages into lung, pleura, adrenals and peritoneum; fractures of rib and of clavicle; rupture of liver, and a sudden death during demonstration of the method. Dr Buist therefore discards Schultze's method for a new one which combines the advantages of all the others. This is practised by placing the child flexed and face down on the palm of the right hand, its head away from the operator, the head and limbs hanging down. The child is then quickly rolled over and almost thrown to the left hand, on which it lies on its back extended, the head and limbs again hanging down. From this position it is again rolled to the right hand, where it lies face down, and so on. Pressure with the fingers aids expiration. Hall's method of rolling the child from face to back is similar.

Whatever method is used, the child must be kept warm, and manipulations must be continued for a long time, some say till the heart absolutely ceases to beat; but cases have occurred in which haemorrhage has destroyed the respiratory centre without injuring the cardiac.

Intubation of the larynx.—This may be done by passing a No. 6 to No. 8 gum elastic catheter into the trachea, through which air may be blown into the lungs by the operator, and expelled from them by compression of the chest. **Mouth-to-mouth insufflation** is easier and less likely to injure the child, and is said to give excellent results. The nose, mouth and throat are cleared, inverting

[1] Trans. Edin. Obstet. Soc., vol. xx. 1894-95, p. 77.

the child if necessary to allow fluids to drain away. Spreading a handkerchief over the face, the operator then closes the child's nose with a finger and thumb, places his mouth over that of the child and blows air into its lungs, preventing its passage down the gullet by pressing the trachea backward against the vertebrae, or by compressing the abdomen. The thorax is emptied of air after each insufflation, and the process may be continued during a lengthy period. In both these methods the blowing must be very gentle lest emphysema be caused. The use of **electricity** is suggested.

Intra-cranial Haemorrhages.

In the child these are oftener meningeal than cerebral. The cavity of the arachnoid is the usual site, but blood is sometimes found under the pia mater and also between the bone and the dura. Vomiting, convulsive movements of the eyes, the facial muscles and the limbs, with stupor and drowsiness, are the usual symptoms, the condition closely resembling meningitis. The prognosis is grave. The treatment consists of cold applications to the head, aperients, and, possibly, operative interference.

Tumours of the Head.

Caput Succedaneum.—Here the effusion is serous, but slight ecchymoses may be produced when pressure is much prolonged. The swelling may pass away in a few hours, or traces of it may remain for several days. No treatment is needed.

Cephalhaematoma.—This is effusion of blood under the pericranium separating it from the bone, and is due to the rupture of a vessel of considerable size. Blood may occasionally be found between the pericranium and the aponeurosis over it. The cephalhaematoma may appear a few hours after birth or only some days later. It may

form a swelling the size of half an orange. Its commonest situation is over the right parietal, next comes the left parietal. The occipital bone is a fairly frequent site, a temporal is more rare. In some cases more bones than one may be the site of swellings of this nature, cephalhaematoma over each parietal being not very rare. The effusion is limited by the sutures to the surfaces of the individual bones. It is commoner in males than in females, due, doubtless, to the larger size of the head. The elevated pericranium produces bony tissue on its inner surface during the gradual absorption of the effused blood, and thus returns to the skull, when absorption is complete, a thickened and roughened membrane. The swelling largely disappears in two or three weeks, but the thickening under the pericranium may be felt for months.

Diagnosis.—The swelling is soft in the centre with elevated firm edges, so might be mistaken for a hole in the skull but for the absence of pulsation. There is no tenderness, heat or redness such as would suggest abscess, unless, as sometimes happens, suppuration has occurred.

The prognosis is favourable as the effusion is usually entirely extra-cranial.

The **treatment** should be expectant, consisting merely in protecting the head from pressure. If inflammatory symptoms or brain irritation appear the swelling should be excised and evacuated. A search will then be made for possible fracture, and it may be necessary to trephine.

Fractures of the Cranium.

Fracture of bones of the skull may occur naturally as in cases of deformed pelvis, or may be due to the use of forceps. The accident may occur in head-last as well as in head-first cases. It may or may not be accompanied by cephalhaematoma. While no symptoms of compression or irritation appear, the treatment should be expectant, but

pressure symptoms demand immediate incision over the fracture, with careful examination and elevation, or removal of depressed portions of bone.

Injuries to Limbs.

The limbs are most frequently injured during turning. Arms may be injured while altering their position when displaced upward. Separation of the epiphysis from the shaft of a bone is a more usual accident than fracture or dislocation. Splints are not easily applied. The upper arm should be bandaged against the thorax, and the thigh should be flexed on the abdomen and bandaged in that position.

CHAPTER XX.

OBSTETRIC OPERATIONS.

VERSION.

THE object of version is to change one presentation into another, and the operation is now usually undertaken in order to convert a transverse into a pelvic case. The head, however, is sometimes substituted for another presenting part. Version is therefore divided into two varieties, according to the part made to present:—

1. **Cephalic Version**—causing head presentation.
2. **Podalic Version**—causing pelvic presentation.

Cephalic version was the original operation, but was entirely replaced by podalic version until recently. Cephalic version, however, has been revived, and is now used in transverse cases when it can be performed, because the risk to the child's life is less in head-first than in head-last delivery.

Podalic version is more easily performed than cephalic, and is more generally applicable. Its value in cases of haemorrhage has been mentioned (see p. 340). The use of forceps has, however, greatly reduced the list of indications for podalic version, which is rarely now used in cases of difficulty when the head presents. Flat pelvis has hitherto been considered an excellent indication for turning, but the use of axis-traction forceps seems likely to replace it even in this class of cases.

METHODS.

The modes of turning are three—1. **External**, 2. **Bipolar** and 3. **Internal**.

External version.—When the membranes are intact and the liquor amnii is abundant, it may be possible to alter the presentation by using both hands externally through the abdominal wall. The patient lies on her back, the head and thorax supported, and the knees up. One hand is applied to the breech, the other to the head, and between pains one is pushed down and the other up. During pains the parts are merely supported so as to maintain the change of position gained during the previous interval. When the desired part occupies the lower-uterine-segment, the membranes are ruptured artificially in order that, after the escape of the liquor amnii, the uterus may retract on the foetus and cause the presenting part to engage in the pelvis. This method may be used for either cephalic or podalic version; it is somewhat difficult and not very often applicable.

Bipolar version.—This method, introduced by Dr Braxton Hicks (1864), consists in using one hand in the vagina to push away from the os the presenting part, while the other hand is placed on the abdomen and used to push towards the os the part which is to be made to present. Either cephalic or podalic version can be performed by the bipolar method, for whose employment the membranes should be intact or only recently ruptured. The patient should be completely anaesthetised, and should lie on the side with the knees raised. This method has the great advantage that it enables version to be performed as soon as the os is sufficiently dilated to admit two fingers, it is thus of infinite service in placenta praevia. The internal hand should be passed completely into the vagina, and the fingers inserted through the os must jerk or push the presenting part in one direction, while the external hand pushes or jerks the opposite part in the other direction. The foetus should be made to rotate in such a manner that the foetal attitude of flexion is not undone. When the desired part is felt by the internal hand to occupy the

lower pole of the uterus the membranes may be ruptured, and if podalic version has been performed one or both legs will be seized and pulled down. If cephalic version has been done, the head will engage in the pelvis after the escape of the liquor amnii.

Internal version.—This is done by passing one hand completely into the uterus, seizing and pulling down one or both legs. It thus demands sufficient dilatation of the cervix to admit the whole hand, and is applicable to podalic version. It should be done as soon as possible after the rupture of the membranes, and should this occur during an attempt at version by the bipolar method, the arm should be rapidly pushed onward till its thick part plugs the vagina and prevents the escape of the liquor amnii. If this is done internal version can then be conveniently performed. Anaesthesia should be complete, and the patient should be on the side, the knees well raised. It is important to ascertain accurately the position, as when the child's back lies to the left side of the mother the left hand should be used, while, when the back is to the right, the right hand should be used. The correct hand, well greased, enters the cervix in conical form and gently dilates it till there is room for the whole hand to be passed into the uterus. If the membranes are intact they should be ruptured near the os, the vaginal outlet being plugged with the thick of the arm. The hand is then advanced with its palm against the anterior surface of the foetus, its back being against the uterine wall. If any pressure is used it must be directed upon the foetus and not upon the uterus. The external hand is kept on the fundus throughout and assists the internal hand. If a pain occur, the fingers must be spread out flat upon the foetus, and no effort can be made till the contraction has passed off. Seizing one or both feet—or, preferably, a knee—between the fingers, the inversion of the child is performed with a slight to and fro motion of the internal hand, aided by the external hand above. During pains no movement

can be made. When one or both legs are brought down into the vagina, and the breech or half breech into the pelvis, the labour continues as a footling case (see page 321).

Indications.

Foetal
- Transverse Presentations when not too late.
- Prolapse of the cord in the First Stage.
- Brow and Faces when the head has not engaged, if it is impossible to correct them into vertex presentations.

Maternal
- Placenta Praevia and Accidental Haemorrhage.
- Impending death from eclampsia or other complications.
- Contracted conjugate with roomy transverse, if axis-traction forceps are not used (see page 418).

In transverse cases with unruptured membranes, cephalic version by the external or bipolar methods may be attempted. In cases where podalic version is decided upon, the bipolar method should be used if the membranes are intact and if there is no hurry. If the case is urgent internal version should be done without employing time over the bipolar method—the cervix being dilated with the fingers if necessary. Where, in complicated head cases, it is necessary to hasten the termination of labour, forceps should be preferred to version where available, as exposing the life of the child to a smaller degree of risk.

Risks.—The legs may be injured in turning. The arms may become extended beside the head, or the head itself may become extended. Rupture of the uterus may be caused. The cervix, vagina and perineum may be lacerated in hasty extraction. The introduction of a hand into the uterus implies a certain risk of sepsis, which should be met by rigid antiseptic precautions.

MINOR MODES.

Fingers.—When the head is on the perineum it may be shelled out by fingers placed in the rectum or in the vagina behind the head. Pressure may also be applied at the sides of the coccyx, and on the skin between the coccyx and the anus.

Fillet.—This is a narrow band of whalebone or of metal bent into a loop, and sometimes fitted with handles and hinged so as to shut up. The instrument has also been constructed so as to take a threefold grip of the head. The loop was passed over the occiput or face and used for traction. It has fallen out of use, as it was not of much service and was liable to cut the head.

Vectis or Lever.—This instrument resembles one half of a straight forceps, with an exaggerated cephalic curve. It has been said to owe its origin to the accidental acquisition of half of a pair of forceps by an obstetrician unacquainted with the appearance and use of that instrument! It was applied as a lever for altering the position of the head, and for exerting a form of traction. Its use is still recommended by some in occipito-posterior cases. With most it has fallen into well merited disuse, and if a practitioner has both halves of a good pair of forceps, it will be but seldom that he will derive any advantage from the use of one of them as a vectis.

THE FORCEPS.

The Evolution of the Forceps.

Peter Chamberlen, born in 1641, is said to have been the first to use forceps in midwifery. The use of the instrument was kept as a family secret by himself and three sons. The existence of this secret was mentioned in literature in 1647, its nature gradually became known, and the

instrument was in use in 1733. Since then it has undergone a process of steady evolution. Forceps in all stages of development may be seen in museums and even in use, some of which are interesting relics of obstetric barbarism. New forms continue to appear, many of which show distinct retrogression from the most advanced types.

Straight (Short) Forceps.—The first forceps consisted of the essential parts only, each half having a blade, a lock and a handle. The blade was fenestrated and curved laterally to fit the foetal head, a pivot between blade and handle on one half fitted into a depression in a corresponding position in the other half. The handles varied in form. These instruments were used when the head was low down. In order to enable the operator to apply it to heads high up the instrument was lengthened by the introduction of shanks between the lock and the blade of each half. But when the head is above the brim, straight forceps introduced in the axis of the outlet cannot obtain a good grasp, for the blades cannot be brought forward from the back of the pelvis, even by pressing the handles against the perineum. As in ordinary labours the sinciput occupies the back of the pelvis, straight forceps, applied to the head when high up, grasp the sinciput. Traction then pulls down the sinciput and causes extension of the head. This destroys the normal mechanism, in which the occiput descends foremost. Thus the first defect in straight forceps is that they do not allow for the elongated shape of the foetal head, which must be grasped so that traction will not destroy flexion and so impede delivery.

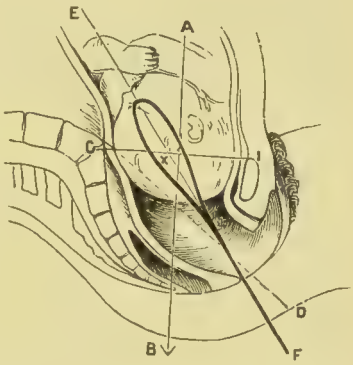


FIG. 48.—Straight Forceps applied at the Brim.

C I = conjugate.
A B = axis of inlet.
C D = axis of outlet.
E F = axis of forceps.
After R. Milne Murray.

This bad grasp also caused the blades to slip off the head with great ease.

Pelvic Curve (Long Forceps).—This defect was removed on the introduction by Smellie[1] and Levret, in about 1747, of the pelvic curve. This is a forward curve in the blade, such that the long axis of the blade makes an obtuse angle with the axis of the shanks and handle, and can lie in the axis of the pelvis while the shanks are in front of the perineum.

Forceps with this pelvic curve being applied in the axis of the outlet, and the handles pressed a little backward, the forward bend of the blade brings it into the middle of the pelvis, so that it grasps not the sinciput but the middle of the foetal head. Traction can now be exerted without causing extension of the head, which descends in the normal manner, and, with this improved grasp, the blades do not tend to slip off. Thus the addition of the pelvic curve removes the difficulty caused by the fact that the foetal head is not a sphere but an oblate spheroid.[2] In

[1] Smellie also devised the English lock, consisting simply of a shoulder projecting from each half of the instrument, which is used in all instruments made in this country. The French lock consists of a pivot on one half, which passes through a hole in the other half, a screw top securing the halves in position when once locked. The German lock has a pivot with a fixed head, fitting into a lateral notch. Either half of a pair of straight (short) forceps can be applied in either side of the pelvis, and when the English lock is used both halves are exactly alike. Long forceps (with pelvic curve) have one half fitting each side of the pelvis, so the blades are right and left. To tell which is which, it is only necessary to think of them as applied in the pelvis of an imaginary patient. For left-sided midwifery it is convenient to apply the left half first and have the lock shoulder to the front of this blade, the shoulder of the right half being to the back. Thus in English instruments the tip of the left blade turns toward the lock shoulder, the tip of the right blade away from the shoulder.

[2] Long curved forceps easily replaced long straight forceps for the high operation; but short straight forceps remained popular for the low operation. Thus all straight forceps came to be made short, and

order to pull the foetal head through the pelvic canal with the least expenditure of force necessary, not only must the head have its long axis in the axis of the canal, but traction must be in the direction in which the head is to move, namely, in the axis of the pelvis. Straight forceps and those with a pelvic curve are alike unsuitable instruments for pulling in the axis of the pelvis. For, looking at Figs. 48 and 49 of straight and curved forceps applied above the brim, it is obvious that pulling on the handles will exert a force in the axis of the instrument (E F). But to pull down the head with the least expenditure of energy, the force should act in the axis of the inlet (A B). While there is any angle between E F and A B, part of the force used is expended in pressure upon the anterior wall of the pelvis, to the injury of the foetal head and of the maternal structures alike. The force exerted in the line E F acts partly in the line A B and partly in the line C I. That part of the force which acts in A B is "effective" in advancing the head, while that acting in C I is "detrimental" and presses the head against the pubic symphysis. The relation between the effective and detrimental forces depends upon the magnitude of the angle B X F. When E F coincides with A B the detrimental force vanishes. Mathematical readers will see by inspection of the diagrams that with E F in any position the relation of the effective to the detrimental force is the same as that between cos B X F and sin B X F.

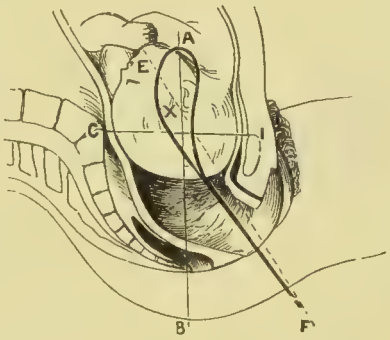


FIG. 49.—Curved Forceps at the Brim.

A B = axis of inlet.
E F = axis of forceps.
B X F = angle of error.
After R. Milne Murray.

all with the pelvic curve long. Thus it happens that straight forceps of any length are called "short;" and curved forceps of any length are called "long."

The following table by Dr Daniel shows at a glance what portions of a 50-lbs. force in the axis of the instrument are effective and detrimental at different angles.

Angle between axis of instrument and axis of brim.	Effective force, *i.e.*, in axis of brim.	Detrimental force at right angles to axis of brim.
0	50 lbs.	0
10°	49.24 ,,	8.68
20°	46.98 ,,	17.10
30°	43.3 ,,	25.4
40°	38.3 ,,	32.13
50°	32.13 ,,	38.3

When B X F = 45° the effective and detrimental forces are equal.
With B X F > 45° the effective force is less than the detrimental.
With B X F < 45° the effective force is greater than the detrimental.

In spite of this defect, which the curved (long) forceps of Smellie shared with straight (short) forceps, instruments of this type are still in general use.[1] Sir J. Y. Simpson applied

[1] The immense popularity of these long forceps with the pelvic curve was due to the fact that their grasp of the head rendered them immeasurably superior to straight forceps for the high operation, while they were at least equally serviceable in the low operation. The only cases in which straight forceps are still thought by some to have an advantage are occipito-posterior positions. Here, the occiput being to the back, it is said that the straight forceps favour flexion, and so aid long rotation of the occiput to the front. Also, the instruments being straight, there is no need to remove them as this rotation occurs. If, however, the curved forceps are used, the long rotation follows, if short rotation of the sinciput to the front has not already commenced. In long rotation the curved forceps are easily removed, and, if necessary, reapplied. If the condition becomes persistent occipito-posterior, delivery with forceps is not specially difficult. Therefore it is not worth while to carry straight forceps on the chance of meeting with occipito-posterior cases. The straight forceps of Ziegler, which are still seen, and recommended for these cases, have one half fenestrated right down to the handle. In application one half is slipped through the other half, and the halves are known as "male" and "female." Short forceps

to them the handles of Naegele, which have shoulders for the fingers to rest upon during traction, and transverse ridges and depressions to improve the grasp. Barnes slightly lengthened the forceps by introducing knees in the shanks, so that after application the knees of the two halves together form a ring just above the lock, through which a finger can conveniently be passed. Simpson's handles, with the shanks and blades of Barnes, are said to form a useful combination. There are numerous minor variations.

In using the long forceps, traction in the axis of the pelvis is attempted, and detrimental pressure on the pubes is avoided, by various devices. All of these depend on the

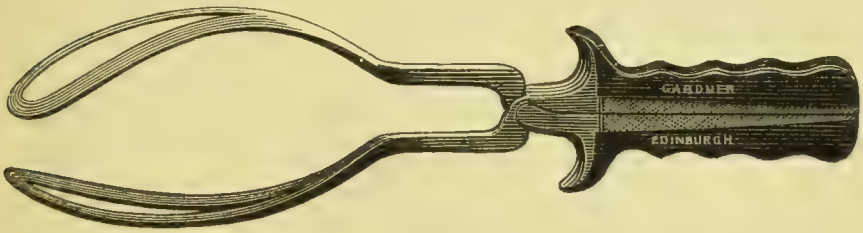


FIG. 50.—Sir J. Y. Simpson's Forceps.

fact that it is possible to apply two forces at a time to the handles of the instrument. For, instead of simply pulling in the axis of the instrument with one hand, both hands may be used. One, near the lock, draws the instrument downward and backward; the other, at the end of the handles, pulls it downward and forward. In other words, the instrument is used as a lever, the resistance being at the blades, the hand near the lock forming a moving fulcrum, and the hand at the end of the handles being the power. The aim is to apply two forces to the instrument, one acting in front and one behind the line in which

are applied laterally as regards the foetal head. Long forceps are always applied one half at each side of the pelvis, no regard being had to the grip of the head so obtained.

motion of the head is desired, and so adjusted that their resultant force shall act in the axis of the pelvis. The use of the two hands in this way is known as Pajot's manoeuvre. Others have used hooks and other contrivances with which to apply the backward component. A handkerchief may be passed round the instrument above the lock for this purpose. Hermann attached a secondary rod or handle behind the instrument, by a movable attachment above the lock, and Foulis made a second handle with a rigid attachment for the same purpose. All these devices have the same aim, namely, to apply two component forces in order to produce a desired resultant. They all have the same defect, namely, that it is difficult or impossible to adjust the components so as to secure the desired resultant.

Perineal Curve.—In order to remove the difficulty of applying two forces, the device was at last discovered of curving the handles backward behind the perineum, till they cross a line drawn through the tip and the base of the blades. When this curve has been added to the instrument it is possible to apply a single force to the handle in the axis of the brim. Aveling's forceps have the application handles themselves bent round backward so that the whole instrument is S-shaped when viewed from the side. Hubert preserved the straight application handles, but added a traction handle, consisting of a rigid bar passing backward at right angles to the shanks, far enough to reach the long axis of the blades. The forceps being applied at the brim, the long axis of the blades coinciding with the axis of the inlet, the traction handle is in a line passing through the tip of the coccyx and the umbilicus of the patient, which is

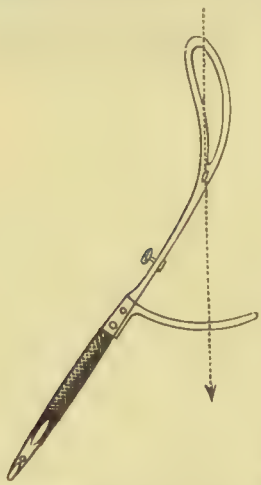


FIG. 51.—Hubert's Forceps. The arrow shows the line of traction. After R. Milne Murray.

usually the same line of the axis of the inlet. By pulling on the traction handle in this line, all the force exerted is effective, acting downwards in the axis of the inlet, and none is detrimental.[1] Thus the problem of axis traction was solved, and an instrument was constructed with which one single force could be applied so as to be entirely effective, given that the operator knows exactly the direction in which to pull.

We have mentioned that in a normal pelvis the axis of the inlet is a line which passes through the umbilicus and the tip of the coccyx, so that having found these points, and if the pelvis happens to be normal, an operator may pull in the right direction *when the head is at the brim.*

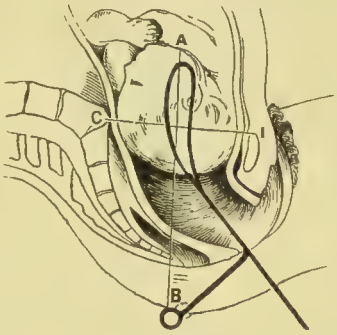


FIG. 52.—Hubert's Forceps applied at the Brim. A B, the axis of the inlet, corresponds with the line of traction. After R. Milne Murray.

But the axis of the inlet varies in direction with different pelvic abnormalities. In flat pelves, for instance, it is directed more backward than normal, and in justo-minor pelves it is directed less backward than usual. It is impossible to know clinically the exact shape of the pelvis, and therefore the operator can never be sure that he is pulling in the right direction at the brim.

After the brim is passed the axis of the pelvic canal curves, and therefore the direction in which traction should be exerted changes every moment, so that it is equally impossible to be sure in what direction to pull *after the brim has been passed.*

Thus, though they allow of traction in the proper line when that line is known, instruments with a perineal curve

[1] Galabin puts the perineal curve in the shanks of his axis-traction forceps, and makes the axis of his handles lie in the axis of the blades, not crossing it, as in Aveling's and Hubert's instruments.

have the very grave defect that they afford no indication whatever of the direction in which traction should be applied. An instrument which leaves the line of pull entirely to the judgment of the operator cannot claim to be an axis-traction forceps.

Axis-traction Rods.—This defect was removed, in theory at least, by Tarnier, who in 1877 brought out his forceps which claimed, besides fulfilling all other desiderata, to indicate the proper line of traction with the head at any part of any pelvis. The application handles are retained, the traction handle is attached to two axis-traction rods. These have a marked perineal curve backward from the application handles. They run up the shanks, and are attached by joints, allowing of free antero-posterior movement, to the bases of the blades. When the traction rods lie touching the shanks the traction handle is in the long axis of the blades.

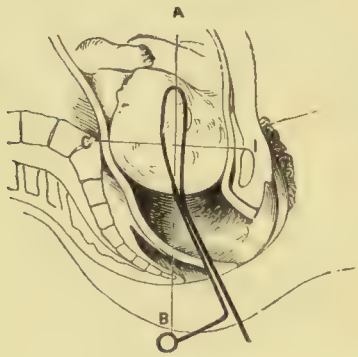


FIG. 53.—Tarnier's Forceps applied at the Brim. Instead of being rigidly attached to the shank, the traction-bars are continued up parallel to the shanks and fixed by a joint at the base of the blade. After R. Milne Murray.

1. These forceps grasp the head in a proper manner, as they have a good pelvic curve.

2. The traction bar or handle is carried well back by the perineal curve in the traction rods, so that traction can be applied in the proper direction.

3. Owing to the jointed attachment of the traction rods the blades and application handles are free to move, so that when traction is applied and the head begins to descend, the application handles move forward with the movement of the head and the blades, and so indicate the line of traction. For, by moving the handle so that the traction rods are kept parallel to the shanks, it is secured

that traction is always in just that direction in which the head is moving at the moment.[1]

Tarnier's[2] instrument was derived from the long forceps of Levret and shared its faults. The improved pattern (1881) is so heavy that the weight of its handles impairs the delicacy of their movements. Professor A. R. Simpson,[3] therefore, applied the traction-rods of Tarnier to the long forceps of Sir J. Y. Simpson, and produced an instrument as much superior to Tarnier's as Sir J. Y. Simpson's is superior to Levret's, being light, rigid, compact, and having the English lock. The different instruments supplied by the makers vary in many particulars, and it is therefore important to understand their construction, and secure a properly built pair of forceps; for though it is impossible to know the details of every pelvis, we can at least make sure that we understand the nature and scope of our instruments.

Points of a good Instrument.—We now indicate what a good pair of forceps should be, quoting freely from Dr R. Milne Murray, who has worked out completely the principles on which the instrument depends, and has reduced every detail of its construction to mathematical accuracy.[4]

The forceps should be light but rigid. No wood should be used in their construction. The blades should have

[1] There is a further defect in all the forceps mentioned before Tarnier's, namely, that they are without any means of holding them in position after locking. It is usual, doubtless, to tie the handles together with string or to wrap a towel round them. When traction is used, however, the handles are pressed together by the hand, and the head is compressed between the blades. The greater the traction the more is the head compressed. Assalini and Lazarewitch introduced instruments in which the blades did not cross in order to obviate this. In Tarnier's, and all traction-rod forceps, a screw and nut is added just below the lock, which is adjusted after locking, and holds the halves in position so that the application handles need not be touched again.

[2] Trans. Internat. Med. Congress, London, 1881.

[3] Trans. Edin. Obstet. Soc., 1879-80, p. 219; Edin. Med. Journ., Sept. and Oct. 1880; and Trans. Edin. Obstet. Soc., 1882-3, p. 143.

[4] Trans. Edin. Obstet. Soc., 1891, Feb. 11th.

a good pelvic curve. The shanks and handles should be straight, and, as they are no longer needed for traction, the handles should be as smooth and light as possible. Each traction rod should be attached to the blade as near its centre as the fenestrum will permit, and for this reason there should be a good expansion of solid metal at the base of the blade.[1] The joints must allow of free antero-posterior movement, but of no lateral motion. The upper part of the traction rods must be close behind the shanks and handles so as to save room and avoid undue pressure on the perineum. The rods continue parallel to and touching

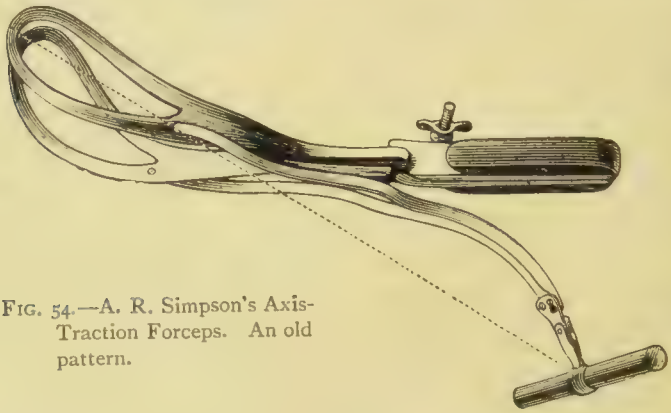


FIG. 54.—A. R. Simpson's Axis-Traction Forceps. An old pattern.

the handles for an inch or so below the lock, when they should curve freely backward. Their point of attachment to the traction handle must be exactly in the same straight line with the tips and the bases of the blades, when the

[1] The traction rods attached at the ends of the blades have a tendency to rotate the blades on the head during traction, and so impair the use of the handles as an indicator. Theoretically, to avoid this, the rods should be attached quite in the centre of the blades, but the fenestrum prevents this. Poullet attached each rod to a bar crossing the fenestrum, but this destroys the use of the fenestrum, and endangers the head. The error due to attaching the rods at the base of the blade is not great even in theory; still, to have the instrument at its best, they should be attached as near the centre of the blade as the construction of the fenestrum will permit.

upper part of the rods is touching the shanks. The traction handle and its attachments must be in the same straight line, and must pull equally on the two rods.

The **Simpson-Tarnier** instrument has the traction rod permanently attached to one traction rod, and it is adjusted to the other after locking. In **Dr Milne Murray's modification** the handle is separate, and the two traction rods are firmly fastened together by a lock, consisting of a pin, mortise and bolt, before the handle is affixed to them. Dr Murray gives a construction by which any one can quickly test the accuracy of a pair of forceps. On a large piece of

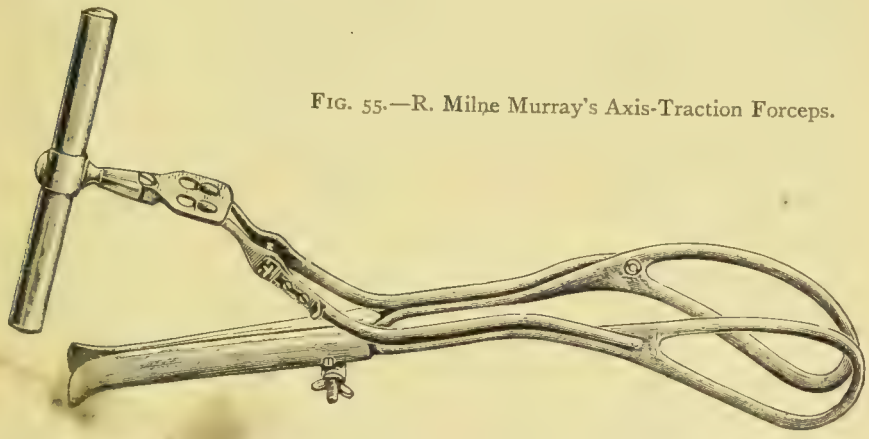


FIG. 55.—R. Milne Murray's Axis-Traction Forceps.

paper trace the outline of one half of the forceps by running round it with a pencil held quite vertically. Mark the junction of the shank and the blade Y; mark the tip of the blade X. Join X Y by a straight line. Bisect X Y by a perpendicular to it, E F. Bisect that part of E F which crosses the outline of the blade V. Draw a circle whose centre is in E F, and which passes through the points X Y and V. This circle G X V Y H is usually about 7 inches in diameter; but it has unimportant variations in different instruments. Draw a tangent A B to the circle, touching it at V. This tangent will be parallel to the chord X Y. Replace the forceps carefully on the paper, and, if they are properly constructed, the end of the traction rod will lie

exactly on the tangent A B, when the upper parts of the rods are parallel to the shanks. See Fig. 56.

Summary of Evolution of Forceps.

Forceps with one curve (the cranial curve).—Known as straight or "short" forceps. Do not take a proper grasp of the head in the high operation, slip off and destroy flexion. Still used by some in the low operation and in occipito-posterior cases.

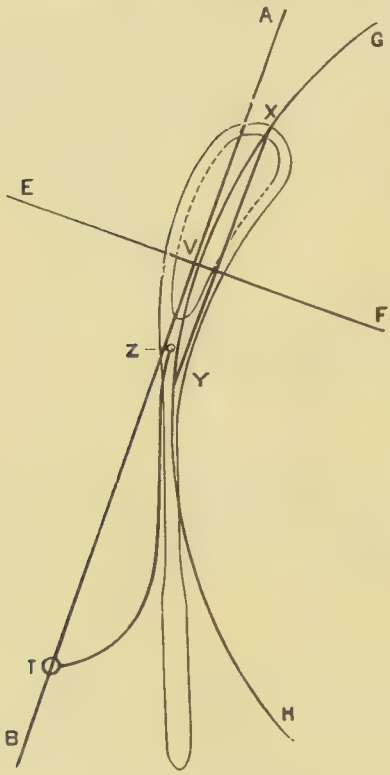


Fig. 56.—After R. Milne Murray. Mechanical construction of Tarnier's Forceps.

V, theoretical position for attachment of traction rods.
Z, practical position of traction rod join.
X, centre of blade tip.
Y, junction of blade and shank.
Z T, traction rod.
A B, line of traction.

Forceps with two curves (cranial and pelvic). —Known as curved or "long" forceps. Take a good grasp of the head and promote flexion. Two forces must be applied to the instrument in order to pull in pelvic axis.

Forceps with three curves (cranial, pelvic and perineal). —Take a good grasp of head. Allow traction in the right direction by a single force applied to the handle, but give no indication of the direction in which traction should be made.

Forceps with three curves, the perineal curve being in **traction rods**, which run up parallel to the shanks to be movably attached at the bases of the blades.—Answer all requirements. Good grasp of head, traction in pelvic axis,

and indication of direction in which traction should be made.

Action of Axis-Traction Forceps.

In the Normal Pelvis.

(*a*). At the brim.—The head is seized so as to promote flexion. The traction handle lies in the axis of the inlet, usually in a line passing through the umbilicus and the tip of the coccyx. Traction can be exerted in the proper direction.

(*b*). In the cavity.—As the head descends, the head and the blades perform movements which are indicated by the forward movement of the application handles. If the traction rods are kept just touching the shanks, traction cannot but be in the right direction.

(*c*). At the outlet.—Here it is stated that forceps tend to cause rupture of the perineum. Tarnier teaches that the traction handle should be abandoned, and that, seizing the application handles, the operator should deliver as with ordinary forceps. To do so is to lose one of the greatest advantages of the axis-traction forceps, for their superiority over other instruments is as marked when the head is passing over the perineum as at any other time. They maintain flexion and prevent extension of the head if used as axis-traction forceps, by holding only the traction handle and carefully following the movements of the application handles. We have seen above (see page 266) that the maintenance of flexion is the chief requisite in preventing rupture of the perineum.[1]

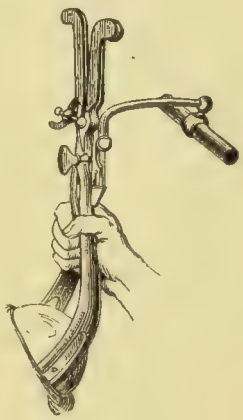


Fig. 57.
Misuse of Tarnier's Axis-Traction Forceps at perineum (Poullet, &c.). After R. Milne Murray.

[1] See J. Halliday Croom, Brit. Med. Journ., 1884, vol. ii. p. 1237, and R. Milne Murray, *loc. cit.*

In Justo-minor Pelvis.—The axis of the inlet is less inclined backward than usual, and its exact direction cannot be discovered clinically except by the use of axis-traction forceps. These indicate it accurately as soon as traction is begun. They also promote flexion and so favour the normal mechanism in this pelvis.

In Flat Pelvis.—The question is whether "forceps" or "turning" is the best treatment in these minor degrees of contraction of the conjugate which admit of the delivery of a living child by one means or the other. The classical teaching is that turning is the proper treatment in flat pelvis, and that the use of forceps is contra-indicated. Whether this view has anything in its favour other than its antiquity we have now to consider.

Version v. Forceps.

In **favour of version** it is stated that it brings down the head so that the narrow bi-temporal diameter passes through the conjugate instead of the broader bi-parietal diameter.

Now where there is room for the occiput to pass to one side of the pelvis so as to allow the bi-temporal to pass in the conjugate, this will occur just as readily in extraction by forceps as in turning. The author has seen this occur in company with other observers.

Where there is not room in one side of the pelvis the head cannot move to one side in extraction by either method.

In favour of version it is also urged that the head is narrow below and broad above, and that, after turning, it thus enters the brim like a wedge, and becomes narrowed laterally and elongated vertically as it is drawn through the brim. But supra-pubic pressure, which should be used in extraction by version, tends to prevent vertical elongation of the head, and we shall see that extraction by forceps allows this vertical elongation to occur.

Against Version.—The child is exposed to greater risk when delivered by turning, both because of the risks attached

to all "head-last" deliveries and because the traction on the trunk necessary to bring the head through a contracted pelvis may injure the neck.

In applying traction by the limbs or trunk it is quite impossible to pull in the axis of the inlet, so that a large proportion of the force used is "detrimental."

Further, turning is easy only before rupture of the membranes; and after the escape of the liquor amnii it soon becomes difficult, and, after some time, impossible.

In **favour of forceps.**—Instruments can be applied at any time, even after all the liquor amnii has escaped and the head has become firmly fixed at or above the brim.

With forceps there is no need to introduce a hand into the uterus.

The risks to the child are not increased by delivery head last.

With forceps it is possible to pull exactly in the axis of the inlet, which is more necessary than usual in flat pelves, because in them the axis is directed more backward than in normal pelves. Forceps[1] compress the head antero-posteriorly, which is of advantage when there is not much room in the transverse. They also allow of vertical elongation of the head, which is prevented by the supra-pubic pressure used in extraction by turning. In flat pelves the instrument takes an antero-posterior grip of the head, and preserves the Naegele obliquity which occurs frequently in nature's mechanism in such pelves.

Against forceps.—It has been stated that the forceps, grasping the head antero-posteriorly, compress it from back to front and cause compensatory enlargement of the lateral diameters. As the head passes the brim with a lateral diameter in the conjugate, increase of these diameters would, of course, render more difficult the passage of the head through the brim.

[1] See next paragraph, and R. Milne Murray, Edin. Med. Journ., Nov. 1888.

But although the forceps compress the head antero-posteriorly, there is no compensatory enlargement laterally. The space lost by compression of the antero-posterior diameters is regained by corresponding elongation of the vertical diameters, and the lateral diameters remain practically unaltered. Dr Milne Murray has proved this by compressing the heads of dead foetuses with a cephalotribe and recording the measurements of their diameters before and after compression. The table shows the results of one experiment :—

Diameter.	Before	And after Compression.		
		I.	II.	III.
Occipito-frontal, .	$4\frac{4}{8}$	4	3	3
Bi-mastoid, . .	$2\frac{4}{8}$	$2\frac{4}{8}$	$2\frac{3}{8}$	$2\frac{6}{8}$
Bi-temporal, .	3	3	3	3
Bi-parietal, . .	$3\frac{3}{8}$	$3\frac{3}{8}$	$3\frac{4}{8}$	3

When the pressure is applied to the back and front of the head the occipital and frontal bones approach one another, their margins slipping under those of the parietals, and the skull being "telescoped." The parietals are elevated, the vault of the skull being removed further from the base, and the vertical diameters increased—so affording room for the cranial contents. Thus the skull is changed in shape without alteration of the lateral diameters.

Summary.—It is a fact that with the ordinary long forceps delivery in flat pelvis was more difficult than by turning. This was thought to be due to lateral expansion of the head caused by the forceps. But the forceps do not cause lateral expansion, and this was not the reason of their failure. The true reason was that with ordinary long forceps it was impossible to pull with sufficient accuracy in the axis of the inlet of a deformed pelvis. With axis-traction forceps this

difficulty is removed, traction can be applied in the right direction, and given a pelvis through which a living child can be delivered, this can be effected by axis-traction forceps with less risk to the mother and to the child than by version. Where these forceps fail, some other means of delivery must be used, and the operator need not be disturbed by the reflection that he might have been more successful had he tried turning.

Modes of action of Forceps.—It is usual to state that the forceps have five modes of action :—Traction, Compression, Rotation, Levering, Stimulation.

Traction is of far greater importance than compression, though this of course occurs—more especially when the head is grasped antero-posteriorly. The instrument should not be used in attempts to rotate the head. When traction brings the head down on to the posterior segment, rotation follows, and is thus aided by the forceps indirectly. Levering is now denounced as a bad practice. In exerting traction a slightly oscillatory or wavy movement may be used from side to side. There should be no "pendulum" movement backward and forward. The presence of the forceps in the parturient canal acts, as would that of any foreign body, as a stimulant to uterine contraction. This is all that is implied by the so-called "dynamic" action of the forceps. We may say therefore that the instrument is used for traction; that compression follows directly, and rotation indirectly upon traction; that levering is to be avoided; and that uterine contractions set up by the presence of the forceps cause trouble during their application, and give an indication as to when traction may suitably be used after their application.

Indications for the Use of Forceps.

The uses of forceps are, on the one hand, to obviate certain causes of delay in the second stage and so prevent

undue prolongation of labour, and on the other hand, to remove certain risks to mother or child by ending the second stage quickly.

Indications. I. Causes of Delay in the Second Stage.

1. **Faults in the Powers** in the second stage are good indications for the use of forceps. Namely, absence or irregularity or misdirection of uterine force, and absence or weakness of accessory powers.

2. **Faults in the Passages.**

(*a*). Soft parts. Rigidity of the cervix is not an indication for forceps, and must be overcome by other means. Strictly speaking this is a first-stage condition. Rigidity of the vagina and perineum are not good indications, but under certain circumstances forceps must be used, with special care to avoid rupture.

(*b*). Bony canals. In justo-minor pelves forceps are to be used, also in all oblique and transverse contractions. Flat pelvis is usually held to be a contra-indication; but see page 408 on this subject. A living child can usually be extracted with forceps when the conjugate measures $3\frac{1}{4}$ in. or over, unless the transverse diameters are also much contracted. With a roomy transverse forceps will extract through a conjugate considerably less than $3\frac{1}{4}$ in.

3. **Faults in the Passenger.**—A large or unduly ossified head may demand extraction by forceps.

Malposition of the head.—In occipito-posterior cases the forceps may be applied early, when they will pull down the head on to the pelvic floor and so aid rotation. In persistent occipito-posterior cases extraction by forceps is indicated.

Malpresentations of head.—Brow and face presentations which, if seen early, would be treated by rectifying the presentation or by turning, if seen late will usually demand the use of forceps.

FIG. 58.—Walcher's Position.

II. Dangerous Labours.

1. **Maternal complications** may demand the use of forceps. Such are convulsions, haemorrhage, heart-disease, phthisis.

2. **Foetal complications** risking the child's life may demand its immediate extraction by forceps. Such are prolapse of the cord and threatened asphyxia from any cause, or the impaction of twins.

Position of the Patient.

In this country the **left lateral posture** is usually adopted in forceps operations, as in ordinary midwifery. The patient must be almost transversely across the bed, the buttocks being brought quite to its edge and the hips flexed.

The **lithotomy posture** is largely used on the Continent of Europe and in America, and is growing in popularity in this country. It causes more exposure of the patient than the left-lateral posture, and assistance is needed for supporting the legs. It has great advantages when any serious difficulty is being encountered.

Walcher's position.—This posture has recently been advocated. It is obtained by putting the patient into the lithotomy posture, the buttocks being quite at the edge of the bed, and allowing the legs to hang freely down, taking care that the feet do not reach the floor. With the patient in this position the conjugate of the inlet is increased, which is an advantage when the head is arrested at the brim. It is found that many heads can be delivered in this position with the axis-traction forceps, after attempts to extract in the lateral and lithotomy postures have failed, the same instrument being used.

The actual increase in the conjugate obtained by the use of this posture has been estimated by comparing measure-

ments of the diagonal conjugate, taken first in the lithotomy posture, and then with the legs hanging down. Walcher[1] estimates the increase at from .8 to 1.3 cm. Klein[2] finds it only .5 to .6 cm. The author[3] found the increase to vary from .8 cm. up to 1.2 cm., the average gain being .93 cm. We may state that $\frac{1}{3}$ inch increase in the conjugate is usually gained. The explanation of this increase is due to the fact that the pelvis of a parturient woman can rotate about a transverse axis, passing through both sacro-iliac joints. (See "bony pelvis" on page 201.) The legs being allowed to hang, their weight acts upon the pelvis and draws the pubic symphysis downwards. But as the axis about which the pelvis rotates is between the promontory and the lower end of the sacrum, this removes the symphysis from the promontory, and approximates it to the tip of the sacrum. Thus the conjugate of the inlet is increased while the antero-posterior diameter of the outlet is lessened. The mobility of the sacrum and its effect on these diameters has long been known, and was described by Duncan as the "nutation" of the sacrum. The new point is that the weight of the legs is used to cause this nutation of the sacrum and enlargement of the conjugate.

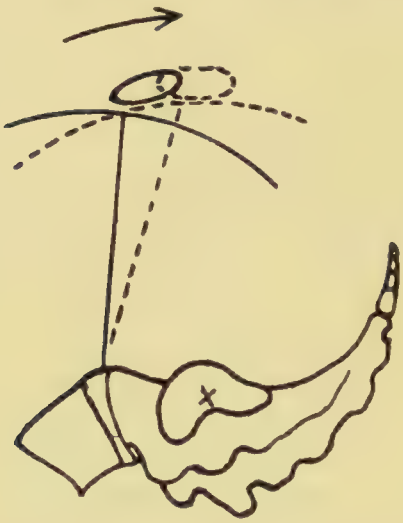


FIG. 59.—Diagram to show increase in conjugate in Walcher's position. The dotted lines show pubes and conjugate with the legs hanging down. The plain lines show the same when the legs are supported. Rotation occurs about the point X.

[1] Centralb. f. Gynäk., 1889, p. 892.
[2] Zeitschrift. f. Geburtsh. Gynäk., Bd. xxi. p. 74.
[3] Edin. Med. Journ., July 1895.

In all high operations, when the axis-traction forceps fails to move the head, the patient may be placed on her back and the legs allowed to hang. Traction will then be found to bring the head through the brim, in some cases which otherwise might be thought to demand craniotomy. Another advantage is that the extension of the legs sets free much skin from the buttocks, and so renders the perineum lax, and much less liable to injury under the pressure of the shanks of the forceps and the traction rods. When the head reaches the outlet of the bony pelvis, the legs should be raised, and the head should be drawn through the outlet with the patient in the lithotomy posture, as this tilts up the pelvis, narrowing the conjugate and much increasing the antero-posterior diameter of the outlet of the bony pelvis. But as soon as the head has passed the tip of the sacrum, the legs should be allowed to hang again, so that the skin of the buttocks may again relax the perineal structures, and allow the head to be born without tearing the perineum. This method of delivery is invaluable in all cases of difficulty through narrowness of the antero-posterior diameters of the bony pelvis, and also when the perineum is in danger. It is necessary to remember the sequence of events:—legs down at the brim, legs up at the outlet, legs down again at the perineum.

Application and Use of the Forceps.

When it is decided to use the forceps, the relatives of the patient must be told what is going to be done. The rectum and bladder must be emptied, and the patient having been anaesthetised to the surgical extent, she must be placed in a convenient position on her side or on her back, according to the choice of the operator. The halves of the instrument, carefully sterilised by boiling or soaking in an antiseptic solution, must be warmed and greased. They may conveniently be allowed to stand within easy reach,

in a jug of warm carbolic lotion, blades downwards. As the left side is the usual posture, nearly all instruments are made to lock most conveniently when the "left-lower-blade" is introduced first.

Applying the left blade.—The left half is first taken up in one hand,[1] the other hand meanwhile being gently introduced into the vagina to make a final examination of the position of the head. The left blade is now passed into the hollow of the sacrum,[2] and, carefully avoiding injury to the cervix by keeping the tip of the blade in close contact with the head, it is then moved round to the left side of the pelvis. Long forceps are always applied laterally as to the pelvis, no regard being paid to their grasp of the head. Thus the blade passes first backward, then upward and forward, the handle being brought backward so that the shank presses against the perineum. The left handle is then steadied against the wrist of the operator or held by an assistant.

[1] The question here arises:—With which hand should the left blade be inserted? The classical teaching is to hold the left blade in the left hand and introduce it into the left side of the pelvis. "La branche gauche, tenue de la main gauche, introduisé à gauche; tout doit être gauche excepté l'accoucheur." This is the only method which is at all neat and satisfactory when applying forceps in the dorsal posture. But many authorities find it more convenient to hold both blades with the right hand, keeping the left in the vagina throughout, and using it to guide into position both blades in turn. This certainly has the advantage that only one hand has to be introduced into the vagina. For under all circumstances the right blade will be introduced with the right hand into the right side of the pelvis. So that when the first blade is introduced with the left hand, the right hand has to be withdrawn from the vagina and the left placed there, before the right blade is introduced. The rule is, in examinations use the left hand for the left blade; in practice use either hand for the left blade which is found to be most serviceable in the interest of the patient.

[2] Many operators do not pass the left blade into the hollow of the sacrum, a course which they consider to cause many faulty and dangerous grips of the head. They pass the left blade directly into the left side of the pelvis, depressing the handle and carrying it slightly backward as the blade is inserted.

Applying the right blade.—In applying the right blade the left hand in the vagina guides the tip of the blade. The right hand holds the right handle, the axis-traction rod being swung well forward out of the way. The right blade is now passed backward into the hollow of the sacrum, and, guided by the left hand in the vagina, is then moved upward and forward into the right side of the pelvis, the handle passing backward toward the perineum to join the left handle. If a pain comes on during the application of a blade, it must

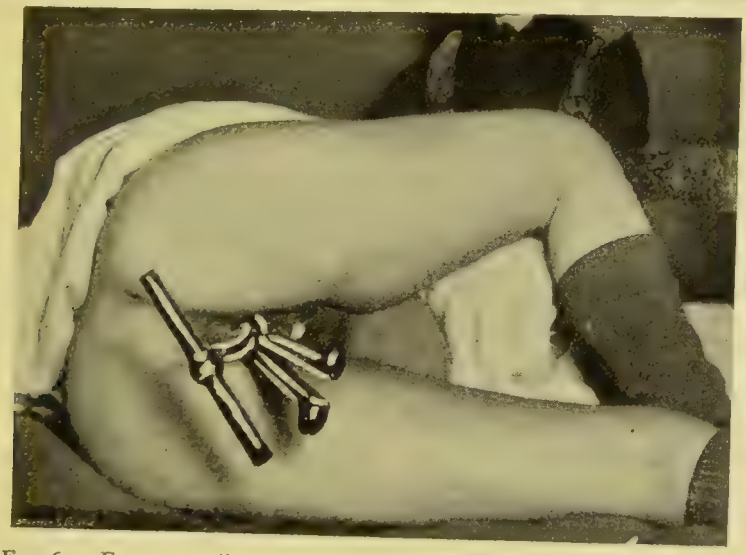


FIG. 60.—Forceps applied. High operation. Photo by Dr A. K. Melville

be withdrawn and the application recommenced after the pain has passed off.

Locking.—One of the application handles is now taken in each hand, and without using force, the positions of the blades are adjusted until the forceps can be locked.

Adjusting.—The traction bars are next swung backward till they lie in their proper position for traction just behind the shanks.

The screw is now adjusted, and its butterfly nut screwed down till it just catches, but no more.

The traction handle is affixed to both traction rods, and

a finger is introduced along the forceps to see that all is right, and that no maternal tissues have been included in the grasp or pushed between the parts of the instrument. Traction may now begin.

Traction.—Taking the traction handle and pulling gently, the direction of the application handles, when not pressed forward by the traction rods, must be noted. Then, bringing forward the traction rods till they just touch the shanks, a strong steady pull may be used. Traction should be used during the pains. If these are absent or infrequent, traction

FIG. 61.—Forceps Extraction. The head is visible. The handles have moved forward. Photo by Dr A. K. Melville.

should be applied for a few moments, and an interval of a minute or two allowed to pass before it is resumed. At the beginning of each pull, the direction of the application handles must be carefully noted to make sure that traction is in the right direction. During the intervals between the pulls the screw should be slackened slightly, but not unhinged.

A slight wavy movement from side to side may be used by the hand, but this should be so small as to be almost

N.B.—In Figs. 61, 62, and 63, no attempt is made to show the correct position of the operator, who, of necessity, stood aside whilst each photograph was being taken.

invisible. Care must be used not to push forward the application handles with the traction rods. Their gradual forward movement as the head descends the curved canal must be simply followed up by moving forward the traction handle. If the patient is on her side the right leg must be lifted as the head nears the vulvar outlet to allow the handles of the instrument to move forward between the thighs. If an inconvenient amount of rotation occurs, the forceps must be taken off and re-applied laterally as regards the pelvis. If the perineum is stretched tightly, the legs

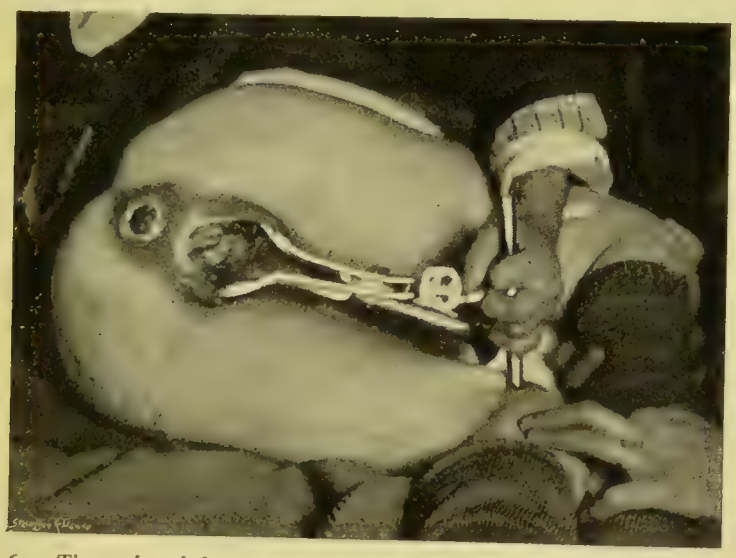


FIG. 62.—The occiput is born. The handles have moved farther forward, as is seen if the position of the patient be noted. Photo by Dr A. K. Melville.

should be kept extended as much as possible. The application handles must not be grasped as the head passes the perineum, but the traction handle alone must be held throughout, checking or accelerating the progress of the head according to the state of the perineum. By using the forceps rigorously as an axis-traction instrument throughout, closely watching and following the movements of the application handles, the perineum will receive the best chance of escaping laceration. When the head is out the forceps

should be removed at once. Delivery with forceps should be slow and gradual, especially if the soft parts are rigid. There should always be a hand on the abdomen, causing the fundus to follow up the retreating breech, and rubbing it, if necessary, to improve contraction. If circumstances have demanded the application of the forceps through a cervix which is not completely dilated, the utmost caution and care is needed to avoid laceration. A finger inserted along the shanks should rest on the cervix during traction to observe the degree of tension, and the force used should

FIG. 63.—Just before the escape of the head. Handles still farther forward. This shows the correct method for bringing the head over the perineum with axis-traction forceps. Photo by Dr A. K. Melville.

be regulated accordingly, plenty of time being allowed for the completion of dilatation.

Dangers of Forceps.

The main dangers to be avoided in using the forceps are as follows :—

1. Injury to the passages through carelessness in application or through sudden occurrence of uterine contraction before a blade has been adjusted in its proper position.

2. Lacerations of cervix or perineum by too rapid extraction or by injudicious movements of the forceps, *e.g.*, "pendulum" motion.

3. Haemorrhage caused by too rapid extraction, insufficient time for uterine retraction being allowed.

4. Injury to the head through an unfortunate grasp being taken. The blade, if possible, should not be over the face, but this is sometimes unavoidable, *e.g.*, in flat pelvis.

Facial paralysis may be caused by pressure of the tip of a blade, and may last for some time, though it usually disappears quickly.

Sloughing of parts of the maternal passages is not due to the use of forceps, as severe pressure for a short time does not have this result. Lacerations may be caused by forceps, but the death of masses of tissue, followed by sloughing (resulting, for example, in vesico-vaginal fistula), is due to prolonged pressure of the foetal head. Thus it is delay before using forceps, and not their employment, which is to blame for these conditions.

CHAPTER XXI.

OBSTETRIC OPERATIONS—*Continued.*

HAVING discussed "Version" and "Forceps"—the means by which living children can be delivered in cases where there is a moderate degree of narrowing or obstruction of the parturient canal—we now consider the methods used when the available space is so small that to accomplish delivery either the child must be reduced or the passage must be enlarged.

Symphysiotomy enlarges the passages, and craniotomy reduces the child. The induction of premature labour avoids the difficulty by causing delivery to occur while the child is still small and soft. These three measures thus compete with each other in cases in which delivery can be accomplished one way or another through the pelvis and vagina.

But the disproportion between the passage and the passenger may be so great that abdominal surgery has to afford a section of this Gordian knot by removing the child through the abdominal wall. The success now attending the Caesarian section is rendering it available for saving the life of the child in cases in which it might be delivered *per vias naturales* after craniotomy, but this need not prevent us from arranging the obstetric operations as follows, to show at a glance their general relationship.

In moderate narrowing, Forceps and Turning.

In considerable narrowing, (1) Symphysiotomy; (2) Induction of Labour; (3) Craniotomy.

In great narrowing, Caesarian Section.

SYMPHYSIOTOMY.

In 1797 Pinaeus examined *post-mortem* a woman hanged ten days after delivery, found the pubic bones movable, and suggested cutting them apart during labour. The separability of the pubes in lower animals suggested the same idea to Sigault, a student in Paris in 1768. He performed the operation successfully 10 years later on five occasions. The operation died out in France, and never gained ground in England or Germany, but in Italy it persisted, and has recently been revived, having had increased success since the introduction of antiseptics. Between 1868 and 1880 Morisani operated 50 times on 48 women, saving 40 women and 41 children. In 1891-94 Pinard operated 49 times in Paris, saving 45 women and 44 children. The operation is now spreading over Europe and America. Dr Donald of Manchester has recently operated successfully in three cases.

Indications.—This operation competes with embryulcia and the induction of premature labour, and may thus be looked upon as one of the steps between forceps and turning on the one hand and abdominal section on the other. Expressed in measurements of the conjugate, its range is probably between $2\frac{1}{2}$ and $3\frac{1}{4}$ inches. Though a large or firmly ossified head might well be extracted from a larger pelvis by this method. In a word, the operation is an addition to forceps extraction, by which a child may be delivered alive through a smaller pelvis than would otherwise have admitted its passage.

Amongst the **risks** are injury to the bladder, haemorrhage, imperfect union, impaired locomotion, and inflammation of the sacro-iliac joints.

Operation.—An incision $1\frac{1}{2}$ in. long is made over the symphysis, and the cartilage is divided with a knife. Separation to the extent of 3 inches may be gained in some cases. The foetus having been extracted by forceps

or turning, the cut edges are adjusted, and in some cases the bones have been firmly sutured. The wound is closed without drainage, and the pelvis is firmly bandaged. The patient is kept in bed for about six weeks.

INDUCTION OF PREMATURE LABOUR.

Of British origin some 150 years ago, this operation reached Germany 50 years later, and was not received in France till a still later date.

The desire to deliver a living child in cases of pelvic contraction led to attempts to reduce the size of the child by starving the mother, but these met with little success. The child is a healthy parasite which is usually well nourished even when the mother is much emaciated by vomiting or tubercular or other disease. The accidental occurrence of premature labour naturally suggested its artificial induction in order to obtain delivery of the child before its full size is attained. The method is also applicable when it is desired to terminate pregnancy prematurely for the sake of the mother. At a time when Caesarian section had a maternal mortality of 57 per cent. and an infant mortality of 35 per cent., and when embryulcia had a maternal mortality of 30 per cent., induction gave only a 4.7 per cent. maternal and 40 per cent. foetal mortality. Though symphysiotomy may largely replace this operation in pelves too small for simple forceps extraction and too large to demand abdominal section, many indications for the induction of premature labour will remain.

Indications.—Induction may be performed when delivery at term exposes to risk mother or child or both, or when the continuation of pregnancy is dangerous.

1. Labour may be induced in favour of both, *e.g.*, in contractions of the bony pelvis with a conjugate of from $2\frac{3}{4}$ to $3\frac{1}{4}$ inches, or $3\frac{1}{2}$ if the transverse or outlet are narrow; or

in contractions due to tumour or inflammatory changes in the soft parts.

2. Pre-existing disease of the circulatory, respiratory, renal, alimentary or nervous systems which is badly affected by pregnancy, also disease due to pregnancy, such as vomiting, renal disease, eclampsia or haemorrhage, indicate induction in favour of the mother.

3. Habitual death of the foetus late in pregnancy, placental disease, or habitual large size of the child indicate induction in favour of the child.

Time.—In general the most favourable time is 230 days from the end of the last menstruation, but careful examination should always be made (see page 100), as the child may easily be lost through delivering it too early, or through waiting until it is too large. The operation may be successful between the 30th and the 36th weeks. The size and shape of the brim and the outlet must be considered in deciding when to operate.

Risks.—The tendency to malpresentations or premature labour is added to by the interference necessary for induction. The child and the mother may both be injured during artificial extraction. There is always the danger of sepsis.

Methods of Induction.[1]

The method now in general use is to pass a new **bougie**

[1] Drugs such as ergot are of no use for this purpose. Reflex stimulation of the nipples and similar methods are also useless. Puncture of the membranes will produce a slow, dry labour, not usually terminated during the life of the child. The object should always be to preserve the membranes. Separation of the membranes by the finger from the lower-uterine-segment, warm douches and digital dilatation are helpful, but uncertain and insufficient. The practice of introducing a bougie between the membranes and uterine wall, and then withdrawing it, has been given up as uncertain and risky. Distension of the vagina with plugs or bags is also uncertain. The injection of large quantities of water between the uterine wall and the membranes has been given up almost entirely.

through the cervix and up one side of the uterus, between the membranes and the muscular wall, for several inches, and leave it *in situ*, the lower end, padded or curled up, lying in the vagina. Uterine contractions usually begin in a few hours, and when these are well established the bougie may be withdrawn and labour allowed to proceed naturally. The risks in this method are rupture of the membranes, separation and injury of the placenta, and slight danger of sepsis. Dr Briggs of Liverpool inserts three or four bougies at the same time, so increasing the rapidity of the process, but multiplying the danger of injuring the placenta.

Pelzer began, in 1892, the **injection of glycerine**, an ounce or two at a time, through the cervix into the lower-uterine-segment, without rupturing the membranes.[1] Glycerine is said to act (1) as a chemical irritant (as in its use in the rectum); (2) by separating the praevial membranes (which any fluid would do); and (3) by removing some of the liquor amnii by osmosis. It seems to dilate and soften the cervix even before uterine contraction is begun. Under many circumstances it is most useful in aiding dilatation, but it is doubtful whether, unaided, it affords the best method of inducing labour.

Barnes bags, and modifications of them, are no less useful for this purpose than in other cases where dilatation must be aided. They should be strengthened where the tube enters them to prevent undue bulging of the portion which is in the vagina when the middle of the bag is

[1] It has been stated that the method is not effective, and that serious toxic effects are sometimes produced by the glycerine, as shown by high temperature, slow pulse, cyanosis, haemoglobinuria and albuminuria. Out of thirty-five cases now reported, in two only did the method fail, one of the patients being moribund and the other having had three bougies in her uterus for days when glycerine was tried. Four women died, two of Eclampsia and two of pre-existent nephritis. Three patients had haemoglobinuria, not apparently due to the glycerine (Helme).

stretching the cervix. They may be filled with fluid from a Higginson's syringe, or with air by means of a small rubber ball (see Fig. 64). Three sizes are usually carried for use one after another.

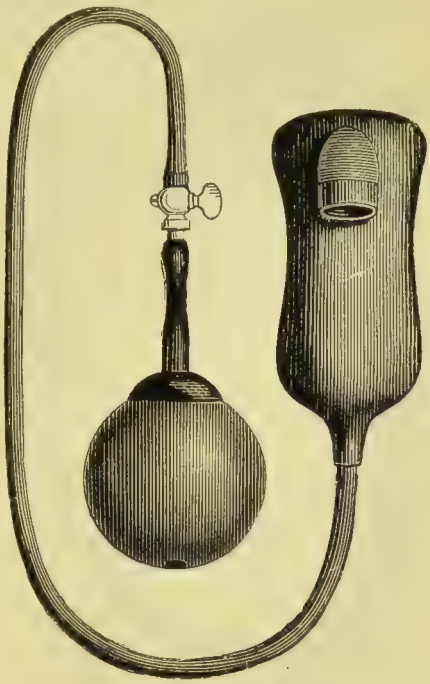


FIG. 64.—Barnes Bag with ball for inflation.

Champetier de Ribes' bag was designed for the special purpose of inducing labour, but has a wide range of utility. Its essential feature is that it is not elastic, being made of strong silk covered with indiarubber. It is conical in shape and has a pelvic curve. Introduced inside the cervix, and filled with fluid, it forms a conical wedge, fitting into the lower segment. The forceps designed for its introduction are not essential, as when the cervix will admit two fingers the bag can easily be passed through it without the help of any instrument (see Fig. 65). This bag may be used to set up uterine contractions and to transmit their force to the cervix, or as a means by which the operator can use the force of his own muscles in dilatation. For when placed in utero the bag acts as a foreign body and sets up uterine contractions in the course of a few hours. It then acts as a fluid wedge, just like the fore waters, and transmits the uterine force to the cervix, which it dilates completely in a few hours more, and so is expelled into the vagina. The presenting part presses in the top of the bag, and does so all the better when it is not quite filled. Modifications have been introduced in order to make the top of the bag per-

manently cup-shaped. When the operator desires to hurry dilatation he can do so by gently pulling on the stalk of the bag and so drawing the fluid wedge down into the cervix. In this way the cervix can be fully dilated in a short time, with less inconvenience to patient and operator than, perhaps, by any other method.

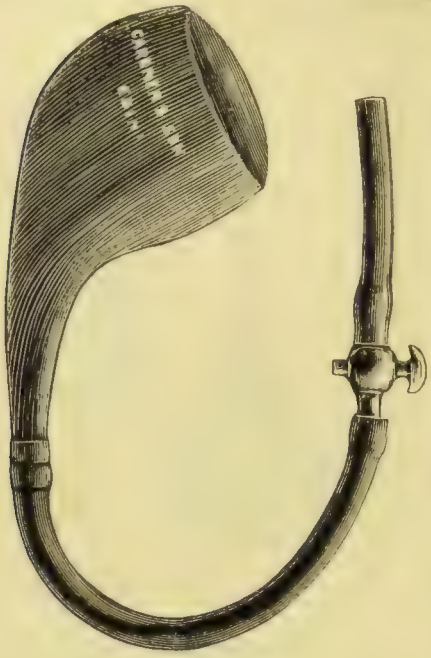


Fig. 65.—Champetier de Ribes' Bag.

Preliminaries.

When it has been decided to induce labour, a consultation having been held, and the date having been fixed with all care, the patient should be prepared by warm antiseptic douching for a few days, and the bowel should be emptied by suitable aperients. A wet nurse should be secured, as it is not safe to experiment upon the premature child with cow's or condensed milk, and its mother's milk is not yet ready for it. An incubator should also be provided, which may be a box with a false bottom, a glass lid and holes for ventilation. The child lies on the false bottom, under which hot water bottles are kept, and renewed sufficiently frequently to keep the temperature at about 98° F. In this the child must lie till near the time when it should have been born, being moved only to be fed and washed.

The Operation.

The method of using the **bougie** has been indicated above. An alternative is to inject ℥iss of **glycerine** through

the cervix by means of a catheter, a rubber tube and a glass syringe. Then put the largest **Barnes bag** in the vagina, and distend it fully with warm antiseptic fluid. The glycerine and the bag together seldom fail to cause, in a few hours, sufficient dilatation for the introduction through the cervix of **de Ribes bag.** The patient may then be left for six hours or so, and when the practitioner returns to her, if he does not find dilatation complete, and the bag in the vagina, he may hurry the process by pulling on the stalk of the bag. Another way is to administer **chloroform**, and then, at one sitting, insert a series of **Hegar's dilators**, follow them with the smaller **Barnes bags**, and then introduce **de Ribes bag.** After starting the process the operator must remain within call of the patient till labour is over. If de Ribes bag is used he should be sent for as soon as the nurse finds the bag in the vagina, as malpresention or malposition may need rectification at once. Labour is terminated, if necessary, by forceps or turning.

Induction of Abortion.

The induction of abortion may be done in order to avoid Caesarian section when the pelvic brim or outlet is very much reduced. It is also demanded by various conditions referred to in the Pathology of Pregnancy, and which need not be enumerated here. A consultation must always be held before inducing abortion. Rupture of the membranes is a poor method, and tends to produce incomplete abortion. Tents may be used, but expose the patient to greater risk of sepsis than does rapid dilatation under chloroform, with copious hot antiseptic douches. Early abortions may be cleared out at once. After the third month it is well to pack cervix and vagina with gauze, after preliminary dilatation, and await results. Glycerine is useful, and a large Barnes bag may be preferred to gauze for producing distension of the vagina.

CRANIOTOMY.

Under the general term "**craniotomy**" are grouped the measures which aim at reduction in size of the foetal head.[1] These operations are of great antiquity, and were doubtless suggested by the ease with which a dead and macerated foetus is extracted. They are becoming less and less frequent owing to perfection in the construction and use of forceps on the one hand, and to the growing success and popularity of cutting operations on the other. For craniotomy, though easy with a conjugate of 3 or even of $2\frac{1}{2}$ inches, becomes very difficult and dangerous when a space of less than 2×3 inches is available at brim or at outlet, and exposes the mother to as great a risk as does the Caesarian operation when skilfully performed. Symphysiotomy also competes with craniotomy. And it is clear that by cutting through the symphysis whenever forceps extraction is impossible, and by opening the abdomen whenever symphysiotomy is not applicable, most cases could be terminated without destruction of the child. But it will be long before the patient and her relatives will consent to the use of cutting operations which can be avoided by sacrificing the child, and for this, if for no other reason, craniotomy will long continue to hold its place amongst obstetric operations.

Indications.—After failure to deliver by forceps, the rule is (symphysiotomy apart) to perforate, without removing the forceps, and then repeat traction. If this fails, comminute the head and extract. After failure to deliver the after-coming head, perforate through the mouth, and then use traction and supra-pubic pressure. If these fail, comminute and extract. Thus failure to deliver by forceps or turning is the usual precursor of craniotomy. The indications may be enumerated as :—

[1] The term embryulcia includes craniotomy, and also embryotomy, or reduction by mutilation of the foetal body.

1. Marked disproportion between the head and the pelvic brim, *e.g.*, conjugate 2 to 3 inches, or larger if the transverse is narrow. Also marked contraction of the pelvic outlet.

2. Obstruction due to tumours, cicatricial contractions, and some inflammatory and congestive conditions of the soft parts.

3. Malpositions and malpresentations that have caused impaction.

4. Hydrocephalus and other foetal deformities—a good indication.

5. The necessity of immediate delivery for the sake of the mother.

When the child is alive, this is a reason for preferring symphysiotomy or abdominal section in cases where either is available. The probable or certain death of the child, on the other hand, points to craniotomy as the proper procedure. Prolapse of the cord thus affords valuable information.

Risks.—The great danger is that exhausting delay may be allowed by hesitating to perforate. When this is to be done, the sooner it is done the better. The intrinsic risks in operating are injury to the maternal passages through boring into the sacrum or allowing the perforator to slip, and laceration by projecting portions of splintered bone during extraction. Shock, haemorrhage and sepsis are further dangers.

Methods.—The measures in use can best be described in three stages—(1) Perforation; (2) Head Comminution; (3) Extraction.

I. Perforation.

The best instrument is Simpson's perforator, whose halves do not cross, so that approximating the handles separates the blades. Smellie's and other perforators are of the "scissors" type. Trephines have been constructed for this

purpose, but are inconvenient and ineffective. A. R. Simpson's basilyst perforates well, and is then used for comminution of the base. A large pair of scissors may be used if no better instrument is at hand.

II. Head Comminution.

Various methods may be used for separating and loosening the bones of the skull and so reducing the bulk of the head.

1. **Craniotomy forceps.**—These are of numerous patterns and include some of the oldest obstetric instruments. The

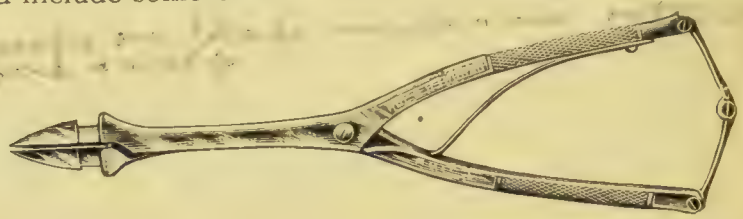


Fig. 66.—Simpson's Perforator.

principle of their use was to begin at the margin of the perforation and break away the vault of the skull bit by bit, —a long and difficult operation.

2. **Cephalotomy.**—It has been proposed to cut or saw the head into two or three separate sections with an ecraseur, but this device has not come into use. (Barnes.)

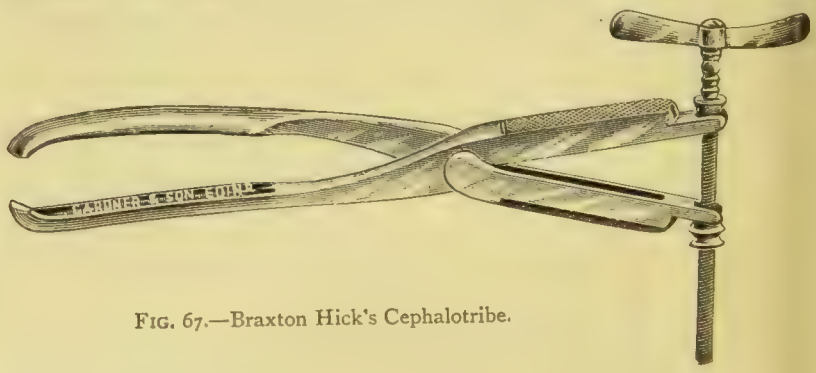


Fig. 67.—Braxton Hick's Cephalotribe.

3. **Cephalotripsy.**—Baudelocque invented the cephalotribe, which is a long, heavy pair of forceps, with unfenes-

trated blades, which are approximated by a screw joining the handles. The blades are applied both outside the head, and were formerly used without preliminary perforation. That of Braxton Hicks, modified from Simpson's, is the cephalotribe best known in this country. The effect of crushing with the cephalotribe is to flatten the head in one direction, bulging it out in the opposite direction. By repeating the process, and taking a fresh grip each time, the head is effectively comminuted. The instrument should be applied as far forward in the pelvis as possible, as it has not a marked pelvic curve. The base of the skull is said to be comminuted, but this rarely occurs; it is tilted but not broken in most cases.

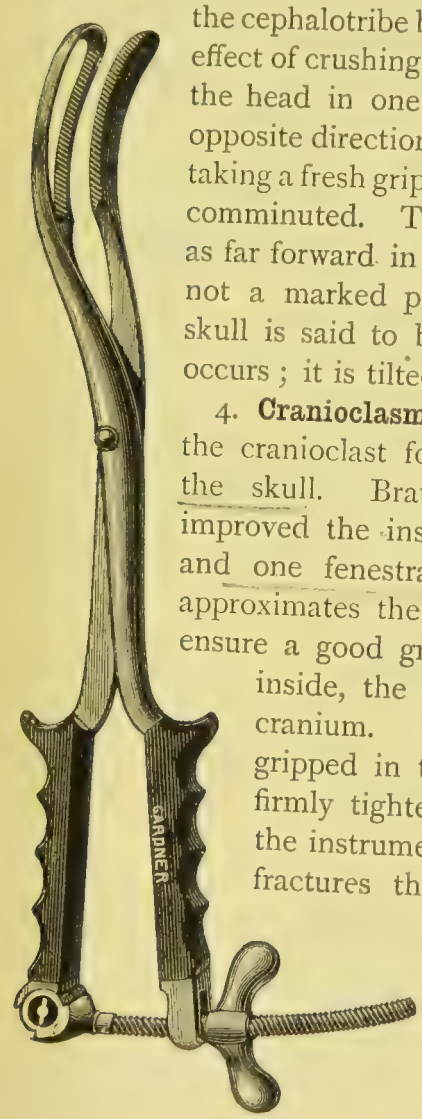


Fig. 68.—Braun's Cranioclast.

4. **Cranioclasm.**—Sir J. Y. Simpson devised the cranioclast for the purpose of breaking up the skull. Braun lengthened and otherwise improved the instrument, which has one solid and one fenestrated blade. A powerful screw approximates the blades, whose serrated edges ensure a good grip. The solid blade is passed inside, the fenestrated blade outside the cranium. The occiput should first be gripped in this way, and the screw being firmly tightened, a twisting movement of the instrument, to right and left alternately, fractures the occipital bone and tears it from its attachments. The sides and front of the skull may be gripped in turn till all the bones of the vault are broken up and separated from the base of the skull, whose component bones are also loosened.

5. **Basilysis.**—Hubert devised a "transforator" for boring

into the sphenoid, and called the operation "sphenatresia." Guyon used two trephines, one sliding over the other, for sapping the base, and extracted with a pair of light forceps. Professor A. R. Simpson invented the basilyst, whose blades when closed form a screw, which is first used for perforating the vault. After separation of the blades has widened the aperture, the point is screwed into the base of the skull,

FIG. 69.—A. R. Simpson's Basilyst.

which in turn is broken up by forcibly separating the blades. To complete the instrument a "basilyst tractor" is added, which corresponds to the outside or fenestrated blade of a cranioclast, while the basilyst itself corresponds to the solid or inside blade. The one instrument thus provides for perforation, complete comminution and extraction.

III. EXTRACTION.

It is now usual to complete the operation by extraction as soon as comminution of the head is accomplished. The method varies according to the instrument that has been used.

Crotchet.—A hook with a fairly sharp point, called a crotchet, or some other variety of hook, was formerly fixed in some recess of the skull, and traction so made. This was a dangerous and ineffective method.

The **cephalotribe** is inconvenient for extraction because it so largely increases the head in one diameter. To overcome this difficulty the instrument should be twisted round after comminution is complete and before traction is begun. This manoeuvre folds the flattened head round the instrument and so reduces its longer, while it increases its shorter

diameter, thus rendering its shape more comparable to that of the canal through which it has to pass.

The **cranioclast** is an excellent extractor, and for this purpose should usually be applied over the occiput, but in certain cases may grip other parts so as to tilt the base of the skull and draw it sideways through the pelvis.

The **forceps** may be sufficient for extraction after perforation and evacuation of the cranium.

The **basilyst tractor,** applied with the basilyst, forms a cranioclast, and is a powerful instrument for extraction or for comminution.

Choice of Instruments.

A. R. Simpson's **basilyst,** with its **tractor,** forms a single instrument with which perforation, complete head comminution and extraction can be well performed. The instrument has not, however, come into general use, probably on account of its great weight. If made lighter and smaller it would probably work as well, and become more popular.

Simpson's is the best **perforator,** and Braun's **cranioclast** is the best combined comminutor and extractor, being a light and most convenient instrument, which allows of any head moulding. These are commonly used together.

The cephalotribe is a heavy clumsy instrument, which does not dispense with the use of a perforator, rarely breaks up the base, but tilts it instead, and though a good comminutor, is a bad extractor. It always gives the head the same flattened shape, and prevents the head moulding suitable to different pelves.

Methods of Operating.

Craniotomy of the presenting head.

The lithotomy posture is the best; the rectum and bladder must be empty. When anaesthesia is complete the

head must be held down and steadied. An assistant can do this by supra-pubic pressure; or if forceps have been applied they may be left in position, as they afford a good means of keeping the head in position during perforation. The point of the instrument, guided by the fingers of one hand, should be thrust with a boring motion **through a bone.** If a suture or fontanelle is perforated, the wound closes as soon as the instrument is withdrawn. To prevent slipping, pressure must be perpendicular to the bone. To secure immediate death of the foetus the point must be carried well to the base of the brain. When *in situ* the blades must be separated in various directions so as to make a sufficient aperture. After removing the instrument, and all loose or projecting fragments of bone, the cranial contents may be washed out with a stream of antiseptic solution.

A gentle attempt at extraction may now be made, with the forceps if they have been kept on the head, but if this is not easy the head should be comminuted by the use of basilyst or cranioclast. After the head is broken up to a certain extent, traction should be used again. If it fails to deliver, the head must be more completely destroyed. Before each attempt at extraction all loose portions of bone must be removed, and the scalp must be made to cover over all remaining projections. Supra-pubic pressure must on no account be forgotten. Traction must be in the pelvic axis, and should be made during pains or at suitable intervals. If delivery of the body is difficult it may be eviscerated.

The third stage demands special care, and a careful antiseptic douche should be given at its end. The head of the child should be stuffed and stitched up. Brains and fragments of bone should be removed at once.

Craniotomy of the after-coming head.

When the child has been turned or has originally presented by the breech, and the after-coming head cannot be delivered, perforation and comminution are necessary.

The perforator s usually introduced behind the ear or below the occiput. Dr Donald of Manchester[1] prefers to perform podalic version before perforating, in all cases of marked pelvic contraction, after which he perforates the base of the skull through the mouth. The head is then comminuted, if necessary, with a cephalotribe, and extracted with that instrument or by traction on the body and lower jaw, combined with supra-pubic pressure.

EMBRYOTOMY.

This term includes the operations applicable in transverse cases where turning is impossible, and having for their object reduction by mutilation of the body of the child.

1. **Evisceration.**—This may be done with scissors, the contents of the abdomen and thorax being pulled out and the body delivered, after which the head is dealt with. This is a tedious, difficult and unsatisfactory operation.

2. **Decapitation.**—When the neck is within reach it should be divided. A blunt hook, or one with a serrated edge, is the best and safest instrument for this purpose. The sharp hook, scissors, an ecraseur or a piece of stout string may be used. If string is employed, both ends

[1] Trans. Obstet. Soc. of London, vol. xxxi. Dr Donald finds that by using this method the base of the skull is effectively broken up, the head is well fixed during perforation, the position of the head is easily altered during comminution, and the head is easily extracted. He finds that, even in cases of marked pelvic contraction, version can usually be performed, with the help of plenty of chloroform, by the bipolar or internal methods; that the body is extracted no less easily before the head than after the head; and that, by securing flexion of the head, pulling the jaw well down, and introducing the perforator far back into the roof of the mouth, the base can be safely and easily destroyed. After perforation the base doubles up into a V-shape, and the vault is compressed and vertically extended under the cephalotribe; while after perforation of the vault this is crushed and the base becomes tilted. The value of this method must be considered in all cases of marked contraction where craniotomy is decided upon.

should be passed through a Ferguson's speculum after one end has been carried round the neck. The speculum being inserted in the vagina, a sawing motion is employed to cut through the neck, chafing of the maternal passages being prevented by the speculum. The string is best passed round the neck with the help of a catheter containing its stylet and bent to a suitable curve. If the blunt hook is used, the neck is severed by applying rotatory force.

After decapitation the body is usually extracted with ease by traction on the arm. The head is then removed by supra-pubic pressure and manipulation below. The forceps may be used, or a perforator and cranioclast if necessary.

3. **Spondylotomy.**—If the neck is not accessible, the attack should be directed against the spine, for, when its continuity is destroyed, the body of the foetus doubles up, and extraction is much more favoured than by evisceration. The spine may be divided with any large strong scissors or with special instruments.

4. **Spondylolysis** by Professor A. R. Simpson's basilyst is a very effective method of breaking up the spine. After either of these operations the body may be delivered by causing it to follow the mechanism of spontaneous evolution, after which the after-coming head is dealt with as usual.

CAESARIAN SECTION.

Abdominal section in obstetrics is of great historic interest, and is by no means confined to modern times nor to European civilisations. In common with all abdominal surgery it has become comparatively safe since the introduction of antiseptic and aseptic methods. The progress of the operation was greatly accelerated when Porro in 1876 began removing the uterus after extracting the child, instead of suturing the uterine wound and leaving the organ in the body. Porro's hysterectomy was at first more successful than the old operation, but modifications have

since so improved the latter that the mortality is at present slightly less after suture than after removal of the uterus.

Indications.—There are two classes of cases in which abdominal section must be performed in the interest of both mother and child, namely:—(1) Those in which delivery is impossible *per vias naturales*, *e.g.*, pelvic contraction allowing less space than 2 × 3 in. at brim or outlet, some tumours, especially cancer,[1] and (2) those in which, after death of the mother, the child can be more quickly extracted by section than in any other way.[2] In certain cases abdominal section is demanded in the interest of the mother, such are—(3) rupture of the uterus, involving the peritoneum, and (4) certain cases of severe accidental haemorrhage with an undilated cervix.

Section may be performed in the interest of the child in cases where craniotomy would otherwise be necessary, but would subject the mother to a risk as great as that of the cutting operation. (5) These are contractions of the bony pelvis, and obstructions due to the soft parts not sufficiently marked to form absolute indications for Caesarian section.

Risks.—These are haemorrhage, sepsis, and shock to the mother. There is practically no risk to the child connected with the operation.

The Operation.

Sänger's Operation.

The vagina and the abdominal wall having previously been rendered aseptic as far as possible, preparations are made

[1] In cancer of the cervix section is always preferable to craniotomy, as the mother is already doomed, and abdominal section is safer for her than incision or forcible dilatation of the cervix.

[2] No woman should be buried undelivered. If the practitioner is present at the time of death, he should deliver the child as quickly as is possible without injuring it. If extracted within five minutes of death of the mother, the child has a good chance of life. Unless the passages are fully dilated this cannot be done by forceps or turning, and section should be performed with any instruments at hand, but with all care.

as for any abdominal section. An extra assistant is present to take charge of the child. A six-inch incision is made in the middle line, beginning 2½ in. above the symphysis to avoid injury to the bladder. The assistant presses the uterus forward into the wound, and, remembering that the left border of the uterus is twisted toward the front, the uterine wall is incised. The child is removed by the head or a leg, contraction of the uterine wound round its neck being avoided. The placenta and membranes are next stripped off and removed, and the uterus is lifted up and brought outside the abdominal wound to be sutured, after it has been ascertained that the cervix is patent. While this is being done a temporary ligature of india-rubber tubing constricts the cervix and prevents haemorrhage, or the broad ligaments and cervix may be firmly held by the assistant while the uterine wound is being sutured. Two or more deep sutures of strong silk or silver wire are inserted for every inch of the wound. They do not include the mucous membrane, but take a good hold of all the rest of the wall. Next, numerous superficial sutures of fine silk or catgut are used, as in Lembert's intestinal suture. Each stitch takes up a bit of peritoneum on one side of the wound, piercing it twice, then crosses the wound, takes up a bit of peritoneum on the other side, and draws the peritoneal surfaces together over the wound. The temporary ligature having been removed, the uterus is, if necessary, encouraged to contract by kneading, and, after being sponged, is returned to the abdominal cavity. This is thoroughly sponged out before the abdominal incision is closed, in the manner usual after ovariotomy. The vagina is douched during after-treatment, and also the uterus if necessary.

Time.—If the operation is done during labour, the dilated cervix provides for free drainage, and the uterus, being already in action, is more likely to contract well after removal of the child. Given daylight and proper assistance,

the most favourable time for operation is near the end of the first stage, before the rupture of the membranes.

Porro's Operation.

This is **Caesarian hysterectomy.** The preliminaries and incision of the abdominal wall are as usual. As the uterus is to be removed, any incision may be used which will avoid injury to the placenta. An elastic ligature is tightened round the cervix as soon as the child has been removed. The placenta is left *in situ.* A serre-noed usually replaces the elastic tubing as a permanent ligature, but is not necessary. One or the other having been firmly tightened, the uterus is cut away together with the ovaries and tubes. The stump is now drawn into the lower angle of the abdominal wound, and fixed there by two guarded pins or two knitting needles, which are passed through it crosswise, just above the ligature, so that their ends rest upon the abdominal wall.

Time.—As the uterus is removed there is no advantage in waiting for labour to begin in order to have the uterus active and the cervix dilated, therefore Porro's operation may be pre-arranged so as to secure daylight and skilled assistance.

Müller's modification.—Some operators prefer to make a huge abdominal incision, and turn the uterus out through the wound before incising it. In this way the risk of allowing blood and liquor amnii to enter the abdominal cavity is somewhat lessened. The ligature also can be tightened before the uterus is incised at all, which lessens haemorrhage, but risks the life of the child. When it is thought that the uterus contains septic matter, or when the child is dead, this modification should be used.

Lawson Tait has the temporary elastic ligature tightened by an assistant simultaneously with the extraction of the child. He then applies his modification of Koeberle's serre-noed as a permanent ligature.

The **Stump.**—The peritoneum at the lower part of the abdominal wound is carefully united round that covering the stump of the uterus, and the wound is closed in the ordinary manner. The portion of the stump above the ligature should be absolutely strangulated. It turns dry and leathery, and separates by sphacelation in from 2 to 12 weeks, leaving a raw depression in the abdominal wall, which granulates under suitable dressings. This extra-peritoneal treatment of the stump is the main disadvantage of Porro's operation, and if it is found, after a sufficient number of experiments, that the stump may safely be dropped back into the peritoneal cavity as after ordinary abdominal hysterectomy, a great advance will have been made.

Choice of Operation.

Sänger's operation in good hands has now a mortality of 9 to 12 per cent., that of Porro's operation being about 14 per cent. Future pregnancy is prevented by Porro's operation, which is an advantage in most cases, but may perhaps be regarded as a misfortune, seeing that one woman has been safely delivered as often as four times by the Caesarian section proper. The removal of the ovaries cures osteomalacia, so that when it is present Porro's operation should be preferred; further, there are other circumstances in which the uterus should be removed. We may therefore state that Sänger's operation should be chosen unless removal of the uterus is indicated by reasons such as the following:—(1). Rupture of the uterus. (2). Presence of septic matter in the uterus, or a child dead for some time. (3). Mollities ossium. (4). Absence of competent assistants and complete antiseptic arrangements, or want of previous experience in abdominal surgery. (5). Previous delay in labour, and rupture of the membranes some time before operation. (6). Marked haemorrhage during the operation, or failure of the uterus to contract.

It must be remembered that malignant or fibroid disease may render it impossible to make a stump, and that when this is the case the uterus cannot be removed. Sänger's modification, the essential feature of which is the use of Lembert's suture to unite the peritoneum over the uterine wound, is generally preferred to the old Caesarian section, in which the uterine wound is simply sutured like the incision in the abdominal wall. Professor Murdoch Cameron of Glasgow, who has done most of the sections in this country, uses the old operation with remarkable success.

Laparo-Elytrotomy.

This operation was introduced by Thomas of New York in 1870, and has seldom been performed. A five-inch incision was made in a line parallel to Poupart's ligament joining the pubic and iliac spines on the right side. The peritoneum was not incised, and the vagina was opened transversely, after cutting through three layers of abdominal muscles. The child was extracted through the cervix and the wound, which was then closed. This was a difficult, dangerous and unnecessary operation, whose main risks were haemorrhage, injury to the bladder or ureters, sepsis and shock.

CHAPTER XXII.

THE PUERPERIUM.

THE **pulse** is slow, especially in multiparae, 60 per minute being a usual frequency just after labour. It returns to its normal rate during the next few days.

The **temperature** is often slightly raised during the first 12 hours, after which it shows slight variations like those of health. A slight rigor is often noticed at the end of labour, and considerable nervous exhaustion is usual. Shock is rarely severe, though some deaths are attributed to it, many of which are due to haemorrhage or some other complication. The **vagina** rapidly contracts after labour and resumes its normal size in a few days. The **uterus** retracts just after labour into a spheroidal mass 4 or 5 inches in diameter. It relaxes later, and in 6 or 8 hours the fundus is usually found about the level of the umbilicus, though its position varies considerably. Webster finds that very little diminution in size occurs during the first two or three days, but the uterus becomes softened and relaxed. Slight uterine contractions, called "after-pains," are physiological in multiparae during the first 24 hours or so.

Involution then begins and progresses rapidly. It is sometimes stated that the muscle fibres undergo fatty degeneration and are destroyed, but this is probably incorrect. Each fibre, doubtless, is greatly reduced in bulk. Very numerous leucocytes are found in the uterine tissue, and its enormous lymphatic supply affords a means of rapid absorption. The vessels of the placental site are plugged

with thrombi, which are gradually removed. The deep layer of the uterine mucosa remains after labour, covering the whole intra-uterine surface. It contains the ends of follicles lined by unaltered epithelium. From these and from the remainder of the spongy layer the uterine mucosa is renewed. In 18 days the follicles are visible, in 30 days a new mucosa is formed, which is complete and covered with columnar epithelium at the end of 2 months. The fundus is at the brim on about the 11th day, and is reduced to its normal size in 6 to 8 weeks.

The **lochia**, or discharge from the uterine cavity during the puerperium, should not be large in amount, and should decrease gradually from the first. It is usually blood-stained the 2nd and 3rd days; serous during the 4th and 5th days, containing a few fragments of decidua; still serous, but mixed with a few pus corpuscles, from the 5th to the 8th day, when it is becoming creamy like ordinary vaginal secretion. The discharge disappears in 2 or 3 weeks. The quantity is increased in those who do not nurse their children.

The **bowels** are sluggish, but the **kidneys** and **skin** are active. Great thirst is often experienced, but the appetite is not great. There may be slight bladder inconvenience, without any active pathological condition. Sugar is frequently present in the urine.

The **mammae.**—The secretion of milk begins on the 1st day in about 2 per cent., on the 2nd day in about 18 per cent., on the 3rd day in about 36 per cent., on the 4th day in about 27 per cent., and a lessening per centage on the subsequent days. Thus the great majority can begin to nurse by the third or fourth day. At first the secretion is clear, and it contains, for a time, numerous "colostrum" corpuscles. (See also page 468.)

Diagnosis of Puerperal state.—This is made by palpation of the flaccid abdominal wall, and bimanual examination of the uterus. Inspection shows fresh purple striae on

breasts and abdomen, and, possibly, lacerations of the vulvar orifice. The lochial discharge may be present with its peculiar odour. "A breast full of milk" is an important sign, but the mere presence of milk in the breast is alone of no diagnostic value, for, as was remarked by a high authority when giving evidence, "a man may have milk in his breast."

Management of the Mother.

The patient should be visited about 12 hours after labour, daily thereafter for 5 days, every other day till the 10th day, and weekly till the end of the month. Enquiry must be made into the discharge, the bladder, the bowels, after-pains, and sleep. The pulse and temperature should be taken and the breasts examined. The baby must also receive due attention (see page 466). If the **lochia** is too large in quantity or remains blood-stained too long, the presence of some clot or decidual remnant in the uterus is suggested. **After-pains** in primiparae, or severity and prolongation of them after the first day in multiparae, suggests a similar condition. If the quantity of discharge is too small, a mechanical obstruction to its flow, or the commencement of an inflammatory process, is suggested. Either condition calls for intra-uterine douching and examination of the uterus.

The **pulse** should be slow. If it rises above 80 per minute there is ground for slight anxiety, if it is more than 100 there is cause for alarm. A rise in the pulse-rate is more serious than a slight rise in temperature, and gives earlier warning of septic mischief. An aperient should be given on the second evening as a rule. The catheter must be used if the patient cannot pass her water with the aid of hot fomentations within ten hours.

The **breasts** may be hard and painful, when they should be rubbed gently with oil. The nipples must be kept dry

when not in use. If there is no baby to nurse, precautions must be taken from the first to prevent trouble with the breasts. They should be smeared with belladonna mixed with glycerine or lanoline (ʒi in ℥i) and padded with masses of cotton wool which will exert elastic pressure upon them. They should then be bandaged firmly and carefully, a separate bandage being used for each breast. The system must be drained of fluid, *e.g.* by giving ʒi of Mag. Sulph. every hour till the bowels are freely moved, and repeating this every day till the breasts have ceased to fill with milk. Pot. Iodide may be given in large doses (20 gr.) the first two days. If these measures do not prevent the breasts from becoming hard and painful, the milk must be completely removed from them by rubbing or a breast exhauster, and patient, long continued massage must be used. Patients must be strongly encouraged to nurse, as they thereby avoid subinvolution and other disorders of the puerperium, and at the same time free the child from the grave risks of artificial nutrition.

The **diet** for the first few days should be but slightly nitrogenous, consisting mainly of milk and farinaceous substances. Greed during the first day or two must be checked. Stimulants should be avoided. White meat and fish may be allowed after the first few days.

Bed should be kept for 10 days, after which the patient may lie on a couch. She may move about her room at the end of a fortnight, and may come downstairs or even go out of doors by the middle of the third week if her condition is normal. Any rapidity of pulse or rise of temperature should prevent the patient from leaving her bed. Subinvolution and uterine displacements are risked if she gets up too soon. Douching with a solution of permanganate of potassium or some other antiseptic is a cleanly and comfortable practice, and does no harm if the nurse is careful to secure perfect cleanliness of instruments and vessels.

PATHOLOGY OF THE PUERPERIUM.

PUERPERAL SEPTICAEMIA.

Causation.

Puerperal fever used to be thought due to conditions of time and place, and was even considered to be a visitation at the hand of God, whereas it is now known to be caused, in almost every instance, by the hand of the midwife or medical practitioner. Very frequent in private practice, it was still more common in the maternity hospitals, whose doors women used to enter in terror for their lives.

Semelweiss first asserted in 1843 that infection was conveyed by the attendant to the parturient woman, after noting in the Vienna hospitals that the wards attended by midwives had a much smaller mortality (3 per cent.) than those attended by the students who frequented the dissecting rooms and the *post-mortem* theatre (10 per cent.). He found just the same changes P.M. in women who died of puerperal fever and in a surgeon who died of blood poisoning from a wound. He lessened the mortality by the use of antiseptics, but the medical world, enraged at having the blame of puerperal fever thrown at its feet, heaped upon him abuse which is said to have hastened his death. Sir J. Y. Simpson further established the identity between puerperal and surgical fever. But it is no longer necessary to trace the steps by which the present view of puerperal septicaemia has been arrived at. It is sufficient to state that it is caused by the ordinary organisms of suppuration, streptococcus pyogenes and the like, and not to the organisms of any special disease. Its apparent occurrence as an epidemic is due to its being carried from case to case by medical men and nurses. The access of sewer gas to the lying-in-room is often found to be connected with puerperal fever, thence the importance of avoiding for this purpose rooms near water-closets or containing sinks.

The pyogenic organisms are not present in the healthy vagina in sufficient number to do any harm, if no blood clot or remnants of placenta or membranes are left in utero to decompose. If, however, the uterus is not completely evacuated, pyogenic organisms in one way or other get into it sooner or later during the puerperium, as if to aid in the disintegration and removal of the fragments of dead tissue, and septicaemia thus appears two or three weeks after labour. Thus the practitioner can cause septicaemia in two ways, (1) by introducing septic matter to the vagina, (2) by leaving organic matter to decay in the uterus. There are doubtless cases in which pyogenic organisms are in the system before labour, when septicaemia may follow, for which no one is in any way to blame. There is reason why pyogenic organisms should produce such profound effects in the puerpera. (1). The rawed internal surface of the uterus is like a great wound wherein organisms can thrive and multiply. (2). The enormously developed lymphatic arrangements for the absorption of effete matter set free during involution of the uterus also favours rapid absorption of toxins and of the organisms producing them. (3). The resistant power of the puerpera is reduced by pregnancy and labour, and may be very greatly lowered by haemorrhage and exhaustion. (4). The blood of the puerpera is already loaded with effete matter, the katabolic products of uterine involution. Thus are provided the two requisites for marked effects of any poison on the system—namely, a large dose and a low resistance.

Living in the favourable environment afforded by the system of the puerpera, pyogenic organisms acquire peculiar virulence, which may account for the marked contagiousness of this form of septicaemia.[1]

[1] It is convenient to limit, as follows, the use of the terms frequently employed. Sapraemia = absorption of toxic *products* of pathogenic organisms. Septicaemia = circulation throughout the system of the *organisms* themselves. Pyaemia = formation in various parts of the

The actual routes by which access to the system is gained are tears of the perineum (accounting for frequency of sepsis in primiparae), lacerations and abrasions of the pudenda and vagina, tears of the cervix, the placental site, and the whole interior of the uterus.

While the various pyogenic organisms cause septicaemia and the other septic troubles of the puerperium, the forms productive of special diseases find in the puerpera a subject which they can favourably attack. This accounts for the disastrous results of premature labour when a woman is already suffering from an infective fever, and also for the frequent fatal results of scarlet fever, erysipelas, and other diseases contracted during the puerperium.

Local Pathological Conditions.

We next glance at various local conditions, which are often treated as separate diseases, but which are parts of puerperal septicaemia. By doing so in this place we see something of its clinical types, pathology, symptomatology, prognosis and diagnosis.

A **ruptured perineum** may become acutely inflamed, swelled and congested, and from nearness to the exterior is a favourable place for sepsis to begin.

Vulva and Vagina.—Swelling, redness and tenderness,

body of new foci of septic activity (metastatic abscesses) from which toxic products or organisms themselves are anew absorbed into the circulation. These three terms may be used to mark the stages or degrees of septic intoxication which occur in puerperal women from the introduction to the parturient canal of the common ordinary organisms of wound infection. Thus we may have a rise of pulse and temperature, slight general fever—sapraemia—which disappears as soon as the uterus has been thoroughly cleaned out with douches and swabbings with cotton wool soaked in strong antiseptics. If this treatment is not carried out vigorously and in good time, high fever results—ordinary puerperal septicaemia. If abscess formation follows in various parts of the body we have puerperal pyaemia exactly like the pyaemia which used to be seen in surgical practice before the days of antiseptics.

with vaginal discharge, are due to septic absorption through tears and abrasions. The bladder may be involved, micturition and defaecation may be painful.

Uterus and Tubes.[1]—Tears of the cervix may be the site of septic absorption, or this may occur through the bared surface of the uterine wall. The inflammation may be superficial or may affect the whole thickness of the wall. The tubes may also be involved and may be distended with pus.

Rapidity of the pulse gives the first warning as a rule, and its rise above 100 per minute is a danger signal. The lochial discharge becomes foetid and may be arrested. There is pain and tenderness in the pelvis. The temperature rises high, and the patient complains of headache; the skin may become yellowish, and the breath has a hay-like odour. Repeated rigors may occur, followed by exhausting perspirations. The tongue is red and dry, digestion is disturbed, and the bowels may be alternately confined and relaxed.

Pelvic Cellular Tissue.—Pelvic cellulitis [2] or parametritis

[1] Those attacks which follow in two, three or four days after labour are due to absorption by the lymphatics of septic matter directly into the general circulation. This so-called septicaemia lymphatica frequently causes general peritonitis and may be followed by purulent suppuration of other serous membranes. Septic symptoms which occur after the completion of the first week are ascribed to the septic decomposition of thrombi in the uterine sinuses. Fragments of these thrombi are broken off and enter the circulation, passing into various organs and causing septic embolism, resulting in septic pneumonia and metastatic abscesses of the liver and other organs (so-called septicaemia venosa), fresh doses of toxins taken into system causing repeated rigors.

[2] Treatment. In the acute stage perfect rest is necessary. Turpentine stupes, applied to the abdomen, relieve the pain. Morphia may be used judiciously for the same purposes. The bowels should be kept in action by saline purges.

In sub-acute and chronic cellulitis, hot vaginal douches should be used twice or thrice daily, and glycerine plugs should be left for 24 hours in the vagina several times weekly. Ichthyol may be mixed with the glycerine for this purpose, and mixed with lanoline or

is caused by the absorption into the pelvic connective tissue of infective material, either from an inflamed uterus or directly through tears in the cervix from the vagina. Exudation of serum and leucocytes follows and causes swelling and tenderness, which travels along broad ligaments, utero-sacral, utero-vesical and round ligaments, and reaching the walls of the pelvis, may fill up the whole cavity with imflammatory deposits. The leg on the affected side is usually drawn up. Vaginal examination will reveal the exact site of inflammation if the condition be slight, but if it be severe the whole vaginal roof will be filled with a firm resistant mass on the affected side.

The fever subsides, as a rule, in one or two weeks, after which the mass may be rapidly absorbed or may remain for months, board-like in hardness. Suppuration is indicated by continued or returning fever long before pus can be detected on palpation of the mass.

It causes pelvic abscess, which may open in the vagina, above Poupart's ligament, in the buttock, after passing through the sacro-sciatic foramen, or into the hollow viscera, but rarely into the peritoneum.

Recovery is usual, but the patient may die early from septicaemia or, after long suppuration, from exhaustion.

Peritoneum.

Local or Pelvic Peritonitis.[1]—Septic infection may reach the pelvic peritoneum from the uterus, tubes or connective tissue. The exudation may be slight, and adhesions may be formed between the uterus and adjacent viscera. On the other hand there may be copious exudation, filling the pelvis, but shut off by adhesions from the abdominal cavity, while the pelvic viscera are matted together into one mass.

vaseline and rubbed into the groins, it seems to have a good effect. Ichthyol is also administered internally. The application of iodine and of blisters to the inguinal regions is frequently useful. Pelvic abscess should be opened early, either by the vagina or above Poupart's ligament.

[1] The treatment closely resembles that of pelvic cellulitis.

Pain in the hypogastrium is severe, micturition is frequent and painful, and there is also rectal trouble. Vomiting is usual, with headache and intense malaise. Pulse and temperature are high, the abdomen is tender and tympanitic. Vaginal examination reveals resistance and tenderness, the uterus is fixed and painful to the touch. Exudation and matting may be found to have rendered the organs undistinguishable. The condition is generally bilateral. Suppuration very rarely occurs. The local condition is not often fatal but may be present along with fatal septicaemia.

General peritonitis [1] may be due to the spread of inflammation from the pelvis to the abdominal cavity. There is abdominal pain and tenderness, the patient shrinks from the touch and avoids movement. There is tympanitis and dyspnoea, with rapid pulse and high temperature, but not, as a rule, cerebral symptoms.

But general peritonitis need not be due to the spread of local peritonitis, for septic infection may be conveyed directly to the peritoneum by the lymphatics. In this case a rigor occurs, followed by tympanitis and dyspnoea, with rapid pulse and high temperature, but with less marked abdominal pain and tenderness. Perspiration is profuse, albumen appears in the urine, and delirium may be an early feature of the case.

These conditions are frequently rapidly fatal, though recovery is not impossible.

[1] Treatment :—Attention to the source of infection must not be neglected, and the uterus and vagina should be thoroughly disinfected. Opium must be used to control the pain. The patient must be stimulated and nourished with the utmost care, alcohol, digitalis or strophanthus and strychnine being, perhaps, the most useful drugs. Quinine, ice-cloths, ice-bags and the bath, are the most satisfactory means of reducing the temperature. Abdominal section, with flushing of the cavity, may save the patient.

Diagnosis.

Warning is given by rapidity of the pulse, foetor of the lochia, with its suppression in some circumstances and increase in its quantity in others. The nature and degree of the attack is determined by the symptoms and signs that have been mentioned in connection with the local pathological conditions. It may be difficult to decide whether the organisms of special diseases are present, but aid is given by the prevalence of any zymotic in the neighbourhood, and by local lesions, such as those of typhoid, by rashes, and by conditions such as the formation of diphtheritic membranes in the vagina. It is also necessary to remember that mastitis can produce general septic symptoms of considerable severity.

Prognosis.

If the condition be one of sapraemia only, the patient will quickly recover under local treatment, for the one source of intoxication being removed, the poison is rapidly eliminated. If, however, septicaemia is present, the condition may be fatal in a few hours by hyperpyrexia or the virulence of the poison, or death may occur in about three weeks, or again not for several weeks. Recovery is not unusual. If the formation of metastatic abscesses shows that the pyaemic state has been reached, death usually occurs in two or three weeks, but may only occur at the end of months after prolonged suppuration. The presence of cellulitis or local or general peritonitis, of course, impairs the prognosis.

Treatment (prophylactic).—This has been discussed in the management of labour. Rigid antiseptic precautions as to the room, the bed, the clothes of the patient, nurse and practitioner must be ensured. P.M. examinations, cases of suppuration, and, above all, other cases of puer-

peral septicaemia should be avoided by both attendants. A complete bath, change of clothes and thorough disinfection of the hands before attending a case of labour should be the rule after any risk of infection has been incurred. All instruments must be sterilised, and it must be remembered that any douche not given by a competent person and with clean apparatus is more likely to introduce than to remove septic matter.

The **treatment** consists in (1) removing the source of infection and (2) adding to the power of resistance; (3) a subsidiary aim being to combat pyrexia. The first object is secured by intra-uterine douches and by swabbing or scraping the endometrium and applying to it strong solutions of phenol or corrosive sublimate. The danger of scraping is that it opens up afresh raw surfaces through which further absorption may occur. The most recent method of removing the source of infection is to remove the whole uterus by hysterectomy, a course which is now securing favourable results. If it is found that sewer gas can by any means gain access to the lying-in room, the patient should be moved at once to another chamber, or, if possible, to another house. The second object is favoured by stimulating and feeding the patient. Alcohol may be used freely, and all the resources of modern therapeutics should be used to secure the nourishment of the patient. The use of antipyretics demands great judgment. Quinine is the best drug for this purpose. It may be given in frequent 3-gr. doses or in larger quantities. The use of cold applications, such as ice bags, ice cloths, the tepid pack[1] and the bath is invaluable in hyperpyrexia. Salines may be given as need arises.

[1] Place a sheet wrung out of water at 100° F. on a mackintosh, roll up one side and get the two together under the patient, wrap her in the sheet and mackintosh, cover with blankets and observe patiently. When the temperature is sufficiently reduced, sponge with vinegar and dry the patient carefully.

The treatment of septicaemia is now being attempted by the injection of anti-streptococcic serum, but with what result remains to be seen.

OTHER PUERPERAL DISEASES.

Uterus.

After-pains.—Some contractions of the uterus occur normally after labour. They are not painful in primiparae, but are so in multiparae. Exaggerated or continuous contractions on the second day suggest the retention in the uterus of clots or portions of the membranes. It is necessary to wash out the uterus, examine it carefully, and give an opiate or other sedative.

Subinvolution, or permanent enlargement of the uterus, is caused by delay during labour, by not suckling, by imperfect evacuation of the uterus, by interference with the pelvic circulation (as when a binder is too tight at the waist). Displacements and subinvolution often occur together, and most frequently are caused by getting up too soon after labour, when the uterine ligaments are still slack and lax. An endometritic condition is often produced, with accompanying leucorrhoea, menorrhagia and pain in the back. Bimanual examination shows the uterus to be enlarged. The treatment should be preventive, but when the condition occurs, iron and ergot may be given continuously. Strychnine and nux vomica are invaluable. Astringent douches (alum, iodine, or corrosive) at about 112° F. may be used twice daily, and three or four times weekly a plug, saturated with glycerine, may be kept in the vagina for twenty-four hours. In chronic cases curetting, followed by applications of iodine or iodised phenol to the endometrium, gives the best results.

Superinvolution, which is atrophy of the uterus, is rare. It sometimes occurs in prolonged nursing, when a condition of galactorrhoea is produced, and has been attributed to

haemorrhage at labour and to nervous disorders. It is practically an early menopause, and has no more definite causes than other examples of the early cessation of the menstrual function. The symptoms are amenorrhœa and sterility, which are not observed till the end of lactation. The uterus is found to be too small, as may be the ovaries and the vagina. A transitory form, which is but rarely diagnosed, recovers in a few weeks without treatment. In the permanent form, treatment is useless.

Bladder.

Retention of urine is usually due to inability to relax the sphincter. It is also caused by swelling of the urethra after crushing during labour, by the pressure of the uterus, and by atony of the walls of the bladder. Reflex irritation from stitches or injury of the perineum or from piles often causes spasm of the sphincter (see page 367). Warm fomentations of the pudenda and hypogastrium often relieve the condition, and it may be remedied by allowing changes of posture during urination. If these fail the catheter must be judiciously used, and the patient should be encouraged to prevent distension by emptying the bladder before it has time to fill completely.

Incontinence is due to paralysis of the sphincter or injury to the bladder. Vesico-vaginal and vesico-uterine fistula are usually the result of sloughing, due to prolonged pressure during delayed labour. Their cure demands operative interference after the raw surfaces have healed.

Frequent micturition may be due to mere irritability or to actual cystitis as well as to pressure of the uterus, or over-distension. Milk diet, demulcent drinks, and alkaline salts are useful.[1] It may be necessary to wash out the bladder with boracic solution.

[1] ℞. Salol, ʒii ; Tr. Hyoscyami, ʒii ; Inf. Buchu ad ℥vi, sig. ℥ss t. i. d., is a very useful mixture in bladder irritability.

Mamma.

When the milk is **absent or deficient** (Agalactia) hot drinks are useful, as the system must be freely supplied with liquid food, chiefly milk; but drugs are not of much use.

Excess of milk early in lactation is not serious. If more is secreted than is needed for the baby, the excess should be drawn off to relieve the breasts, and the quantity of fluid entering the mother's system should be reduced by regulating her drink. Salines may also be given to remove fluid by the bowel. Later on excessive secretion of milk is usually caused by undue prolongation of lactation. It is exhausting to the patient, who becomes thin, weak and anaemic, and is troubled with sleeplessness and headache. In this condition of galactorrhoea, the milk contains an unduly large proportion of casein, which upsets the child's digestion. The secretion should be checked by the external use of belladonna, by free doses of potassium iodide, by saline purges, and by restricting the amount of fluid drunk. The course to be followed, when nursing is impossible, has been mentioned (page 449).

Depressed nipples should be attended to during pregnancy (see page 103). The child may have to suck through a shield.

Fissures and **excoriations** of the nipple cause intense pain during suckling, and admit septic matter which may produce mastitis. They are easily formed if the skin is too hard. Therefore hardening of the nipples by spirituous and astringent applications must be done with great judgment, and the pliability of the skin should be preserved by the use of emollients, such as lanoline. The nipples should be bathed frequently with boracic solution, and carefully dried, and powdered with, for example, a mixture of starch powder and zinc oxide. If the milk oozes out and tends to keep the nipples wet, they should be protected

by grease applied freely immediately after they have been washed and dried. Cauterising the fissures with nitrate of silver is of no use unless the nipple is rested after it till healing is complete, for as soon as the eschar is sucked off, the condition is worse than ever. This is a bad though common treatment. Glycerine with tannin or borax may be useful. The child should be made to suck through a nipple shield.

Mastitis.—Short of actual inflammation, great distress may be caused by accumulations of milk in parts of the gland. Hard, tender lumps are felt, which should be patiently rubbed away with the hand, using warm oil as a lubricant, and care should be taken to completely empty the breast at frequent intervals. If this is not done, larger areas become hard and inflamed, and it may be necessary to rest the breast, and even to stop secretion by belladonna and saline purges. The breasts should be well padded and supported by bandages. If suppuration occur, septic organisms entering the gland by the tubules or through fissures in the nipple, early incision should be made. This should be done under chloroform, the incision should radiate from the nipple, so as not to cut across the tubules of the gland, and should not involve the areola. The septa between separate abscess cavities should be broken down with the finger, and free drainage must be secured. Poultices may be applied from the commencement of suppuration till the incision is made, after which wet dressings should be continued for some time. There may be considerable fever, which is sometimes called "milk fever," but which is simply septic intoxication. The name is often applied to fever due to septic absorption from the pelvis.

Galactocele is a retention cyst in the breast, caused by obstruction of a lacteal duct, a rare condition, which should be treated by incision.

Haemorrhage.

Secondary Haemorrhage.—There may be too much blood mixed with the lochia, when bleeding is slow and continuous; or sudden and copious losses of blood may occur. The usual cause is the retention in utero of a placental relic or a blood clot. Other causes are pelvic congestion, too great or too early exertion, inversion or retroflexion of the uterus, an atonic condition of the organ, or a state of the blood.

Careful examination of the uterus is demanded, though, if the os is closed, palliative treatment may be tried before dilating it. Perfect rest must be secured, and ergot, iron, strychnine and other haemostatics may be given. The more active treatment is exploration and cleaning of the whole uterine cavity. This should be done with the help of an anaesthetic; and after douching with water at 120°F., liniment of iodine may be applied to the endometrium by means of a sound armed with cotton wool. It is rarely necessary to plug the uterus or to make use of perchloride of iron. The latter measure is, however, less objectionable when the puerperium is somewhat advanced than it is just after labour.

Haematoma may form after labour is over, by the effusion of blood into the lacerated tissues surrounding the canal and its outlet. Absorption of the effused blood gradually occurs, but suppuration may take place, in which case an incision should be made, the clot being removed and the cavity drained.

Phlegmasia Alba Dolens.

This painful condition, known as "**white leg,**" is due to thrombosis of the large veins, or to inflammatory processes affecting the lymphatics, and follows injury to the parturient canal, sepsis and haemorrhage. Both legs may be attacked

simultaneously or one after the other, but the left leg is most frequently affected, owing, perhaps, to the presence of the rectum in the left side of the pelvis. The arms may be the site of similar conditions. There is painful swelling extending from the foot to the groin; the skin is clear, white, tense and shining, showing through it the superficial veins. The tissues may be too tense to pit on pressure, and the hardened course of the veins may be detected by the finger. The pulse is rapid and the temperature is raised, constipation and loss of appetite are usual. Suppuration or gangrene may occur, and the risk of embolism is grave. At best the limb remains useless for a long time. The pain and swelling usually disappear in from 3 to 6 weeks, but permanent thickening may remain. Recurrence is not rare, so that at the next labour it is wise to prevent delay and haemorrhage by way of prophylaxis.

Treatment.—The limb should be elevated and swathed in padding. Laudanum may be applied externally, and opiates may be administered to relieve the pain. Purgatives and antipyretics may be needed. Iron and other tonics should be given continuously. When the painful period has passed, the patient must still be kept in bed for 2 to 3 weeks, during which careful massage and passive movement should be used, followed by gentle exercise when this can be allowed.

Embolism and Thrombosis.

While thrombosis of pelvic veins is a cause of phlegmasia dolens, it may also cause **embolism of the pulmonary arteries.** Obstruction of these arteries by portions of clot which have passed through the right heart is one of the most frequent causes of sudden death during the puerperium.

Primary thrombosis of the pulmonary arteries also occurs, and is favoured by all circumstances tending to cause coagulation of the blood. A sudden attack of dyspnoea, following some slight exertion four or five weeks after labour

may be fatal at once, or the patient may recover from the attack to struggle with the pneumonia which must follow. The prophylaxis consists in preventing exertion for some time after the cure of any venous thrombosis, and, of course, in preventing delay and haemorrhage during labour and sepsis after it. The attack of dyspnoea demands stimulation by alcohol, ether, strychnine and digitalis; and venesection may save the life of the patient. Absolute rest is essential during the treatment of the resulting pneumonia.

Embolism of systemic arteries is rare, but occurs in old rheumatic or endocarditic cases, or where there has been acute puerperal endocarditis from sepsis. Fragments of clot from the left heart form the emboli. Plugging of an artery in a limb is followed by pain and oedema, which pass as collateral circulation is established. Plugging of cerebral arteries causes death or destruction of more or less of the central nervous system.

Puerperal Insanity.

Ten per cent. of all cases of insanity in the female are said to occur in connection with child-birth. Of these cases 18 per cent. begin during pregnancy, 47 per cent. during the puerperium, and the rest before the end of lactation.

Those cases beginning during the puerperal month are usually maniacal in type, and less frequently melancholic. Their cause may be traced to heredity, to too many pregnancies, to exhaustion and haemorrhage, or to the shame of illegitimacy. The transitory mania of labour is held by the law to excuse injuries inflicted on the child by the mother at or soon after delivery. The first symptoms are sleeplessness, restlessness, unaccountable dislike for her child or relatives, or for the nurse or practitioner. These are followed by the noisy state of mania or by profound depression. The earlier the onset, the better the prognosis, but the condition is liable to recur. The occurrence of melancholia at a later date is more serious.

The patient must be constantly watched, so that the presence of two competent attendants in the house is almost necessary, as the friends must, as a rule, be kept out of sight of the patient. Food must be administered by force if necessary. The advisability of sending the patient to an asylum is always in question; for, in an institution, the patient has special attention and treatment, is away from friends, and has change of air and food. But in these cases the probability of recovery is so very much greater than ordinary that it is only under necessity that the patient should be sent away, probably to come back quite well, but with the lasting stigma of having been in an asylum. If proper attendance and care can be afforded, the patient should therefore be kept at home, unless there is any suicidal tendency or the disposition to injure others.

CHAPTER XXIII.

HYGIENE OF INFANCY.

Umbilicus.— When the cord has been tied, cut and dressed with care, it should give no further trouble. A line of demarcation forms soon after the placental circulation ceases, and at this line the shrivelled two inches of cord separates in the course of a week, leaving a small sore which soon becomes covered with skin. Neglect of cleanliness may lead to inflammation and septic absorption from the raw surface, which should be treated by antiseptic wet dressings.

When the placental circulation ceases, thrombosis occurs in those parts of the umbilical arteries which extend from the bladder to the umbilicus, lying one on either side of the urachus or stalk of the allantois, and also in the umbilical vein, where it leaves the umbilicus and runs below the liver. The contraction of these vessels, as they shrink into fibrous cords, draws inward the umbilical scar. Patency of the stalk of the umbilical vesicle (Meckel's diverticulum of the intestine) must be looked for, also patency of the urachus causing communication with the bladder. Bleeding from the umbilicus suggests a bad condition of the blood or hepatic disease, and may be fatal. Powdered persulphate of iron is a good styptic. It may be necessary to transfix with a needle, and wind a ligature round and round, under its projecting extremities. Exuberant granulation at the scar may be checked with sulphate of copper. (See page 268 on time for tying the cord.)

Mammae.—Secretion may occur in the mammae of male or female infants, during the first or second week. No attempt should be made to express the secretion, which should be checked by pressure and belladonna.

Bladder and Rectum.—The anus and urethral aperture should be examined at birth, in order that any abnormality which will require surgical interference may not be overlooked. On calling 12 hours after labour, enquiry should be made whether the bladder and rectum have been emptied. The urethra may be found to be impervious, and many conditions may call for attention. If the prepuce is tight, early circumcision should be recommended.

Eyes.—These should be frequently and carefully bathed, and if there is any chance of gonorrhoeal infection, corrosive lotion (1-2000) should be dropped into them at birth.

Clothing.—The dress of the infant should be warm and loose. A flannel binder, usually fastened with a few stitches, preserves in position the umbilical dressing.

Washing.—The child should be washed all over twice daily. At first both baths should be warm. Later the morning bath may be made gradually colder. Dusting powder should be freely used after drying the skin thoroughly. Each time the child's napkin is changed the parts should be carefully washed, dried and powdered. Fuller's earth, zinc oxide or carbonate, and bismuth are useful as dusting powders, in combination with starch powder.

Sleep.—The child should be trained from the first to sleep at the proper times, being roused only when cold, wet or hungry. It should be placed in quiet, and if accustomed to sleep alone when very young, it will not make any objection to doing so when older. A well-trained infant will sleep in its cot for at least 16 hours out of the 24. Plenty of fresh air and plenty of light are as essential to the life of a child as to that of a plant.

Lactation.

For the sake of the child, even more than for the sake of the mother, human milk should be infinitely preferred to any form of artificial nourishment. 17 per cent. of infants die under the age of 1 year, and 33 per cent. die under 2 years, while 45 per cent. of all deaths are stated to occur in those under 5 years of age. It is certain that a large proportion of the mortality of infancy and childhood is due to artificial feeding. To give a single example, out of 500 deaths from diarrhoea in infants in Manchester, during August and September 1895, Dr Niven found that only 15 (3 per cent.) occurred in children fed at the breast. Holt of New York and Hope of Liverpool give similar figures. A child not nourished by mother's milk during the early months of its life suffers from the lowering of its powers of resistance against all forms of disease during both infancy and childhood.

The **secretion of milk** usually commences on the third day, and before this the infant needs little or no nourishment. A little sugary milk and water is usually given. The child should be applied to the breast two or three times on the first and second days, but it should not be allowed to persist in futile efforts, as disappointment may cause it to refuse to suck later. To allow of sucking, the tongue must be freely movable, so as to press the nipple against the roof of the mouth. In hare-lip and cleft-palate it is necessary to draw the milk from the breast and give it to the child with a spoon. The first secretion is the so-called "**colostrum**," comparable to the "beastlings" drawn just after a cow has calved. This is a yellowish clear fluid containing numerous colostrum corpuscles, which are large granular nucleated cells discharged whole from the acini of the mammary gland. The nitrogenous element in colostrum is albumen, which coagulates on boiling, and not the casein of ordinary milk.

Colostrum acts as a natural stimulant to the bowel, and if the child swallows it, the castor oil usually given by the nurse is quite unnecessary. Frequently, however, the early secretion is distasteful to the infant, and in this case it should be drawn off until the bluish-white milk appears before sucking is attempted.

The **first three days** may thus be considered as an initial stage of lactation, during which the secretion is instituted and sucking commenced.

The **second stage** lasts almost seven months, during which the flow of milk should not diminish, and should afford the whole food of the infant. The child should at first be fed every 2 hours during the day, but should sleep 3 or 4 hours at a time during the night. The intervals between its meals should be gradually lengthened to 3 or 4 hours during the day, and 6 or 7 hours at night. It must be remembered that over-nursing increases the amount of casein in the milk, and so upsets the child as well as exhausting the mother. If too much milk is given at a time the child vomits, which does no harm. It is most important that suckling should be confined to definite times. The practice of applying the baby to the breast every time it cries, from whatever cause, should be discouraged in every possible way.

The **third stage of lactation** extends from the commencement of dentition[1] until the child is weaned, which should be during the 9th or 10th month. During this period the flow of milk decreases gradually, and if not unnaturally

[1] Dentition occurs normally as follows: First group of teeth—2 lower incisors appear in the 7th to 8th month. Second group—4 upper incisors appear about six weeks later. Third group—4 molars and 2 lateral lower incisors appear in the 10th to 12th month. Fourth group —4 canines appear in the 18th to 22nd month, and, coming in between other teeth, cause extra trouble. Cough, fever and gastric disturbances occur along with dentition. Weaning and change of diet have a favourable effect. After the appearance of a tooth, a few days should be allowed to elapse before making further addition to the diet.

encouraged, ends between the 9th and 12th months. A little farinaceous food well cooked and mixed with cow's milk should be added to the child's diet during this period.

The **diet** of a nursing woman should not be different in quantity from her ordinary one. Over-feeding is very common during lactation, but over-drinking of stout is still commoner, quite as unnecessary, and even more injurious. Milk may be drunk freely. Certain vegetables, such as turnips, have a deleterious effect upon mother's, as upon cow's milk. Rhubarb is also injurious.

Too much meat in the mother's diet causes the milk to contain too much fat and too little sugar, and this change will produce diarrhoea in the infant. Drugs taken during lactation are also liable to affect the milk injuriously, and care is called for in prescribing them.

Mother and child should be out of doors as much as the weather will allow. A tranquil mind should be preserved, as the exercise of the passions and emotions often has a bad effect upon the milk.

Contra-indications for lactation.— Many women are quite unable to nurse, and others who might do so should not be allowed to. Elderly primiparae seldom have much milk. Women who have had several children in succession, or who have had one child soon after another, seldom have good milk. In some cases of galactorrhoea, watery, useless milk is secreted in abundance, which exhausts the mother and is no use to the child. Women with actual tuberculosis should not be permitted to nurse. The occurrence of menstruation or conception during lactation are also indications for its termination.

If the mother cannot nurse, the best substitute is a wet nurse, and, if possible, one should always be secured rather than use the bottle. In cases where the mother has nursed her child for six or seven months, but has to cease doing so for any reason, artificial feeding should be preferred to the employment of a wet nurse.

Choice of a Wet Nurse.—It is the physician's duty to see that, physically at least, any woman employed for this purpose is thoroughly fit for it. The breast and nipples must be in good condition, the milk must be abundant and of good quality. She should not be too young, 20 to 25 being the best age. It is essential to avoid tubercular women, and syphilis must be looked for with the greatest care, examining the tongue, teeth, skin, glands and hair. Her own child should always be seen and carefully examined, to see that it is free from eruptions, cracks round the mouth or anus, or other signs of disease. The age of this child should not much exceed that of the one to be nursed, or the supply of milk may not continue as long as it is wanted. Wet nurses must be carefully prevented from over-eating, and must be made to take enough exercise. They sometimes drug the child to keep it quiet, and need a good deal of looking after.

Artificial Feeding.

The bottle.—The bottle with long rubber tube should never be used. It is difficult to keep the tube clean, and the baby can lie in its cot with the bottle and absorb the contents at its leisure. These are two great disadvantages. For the least sourness or impurity of the bottle is liable to set up gastro-intestinal disturbance that may kill the child. Further, allowing the infant to have the bottle and suck at it when it pleases is as bad as nursing it indiscriminately whenever it cries, and destroys both the digestion of the child and the peace of the mother. The bottle should therefore be one which must be held by the nurse during the imbibition of its contents, with no tube, but a simple india-rubber teat which can easily be turned inside out for cleaning. Two bottles should be kept for alternate use. After each has been used it should be boiled for five minutes, and kept soaking in weak boracic solution till wanted.

The food.—In composition the milk of the **ass** approaches mother's milk more closely than that of other domestic animals. If procurable it may be given undiluted. As a rule some modification of cow's milk must be used. Different samples of cow's and of mother's milk vary extremely, but their average composition is expressed below.

	Butter.	Sugar of Milk.	Casein.	Salts.	Total Solids.
[1] Mother's milk	3.4	6.7	2	.2	12.3
[2] Cow's Milk .	3.9	4.3	4.0	.65	12.85

Cow's milk thus contains more solid constituents and is richer in casein. Mother's milk is more watery and contains more milk sugar. But there are other differences. For soon after leaving the udder of the cow, the milk cools and undergoes fermentative changes. It rapidly becomes acid in reaction, though at first, like mother's milk, it is slightly alkaline. As a rule it is exposed to contamination from many sources on its way from the cow to the consumer. If an infant vomits mother's milk it is seen that a small light curd has been formed, while, if it vomits cow's milk, the curd is in large heavy masses.

In **preparing** a **bottle** for an infant several points must therefore be attended to.

1. The food must be **warmed**, and should be given slightly below the temperature of the body.

2. The milk used should be **sterile.** This may be ensured by boiling, but better by "scalding," *e.g.*, allowing the vessel containing the milk to stand for about half-an-

[1] Ashby. [2] Walker-Gordon Laboratory's milk.

hour in water which is boiling. It is still better to use a good "steriliser," in which the milk may be exposed to a high temperature for 30 or 40 minutes, and kept, thereafter, carefully sealed up till wanted. These processes are less needed in the country than in town, and it must be remembered that they all render milk somewhat less digestible. It is wiser to use the average milk of the dairy than that supposed to come from a single cow. Before use, milk should be kept as cool as possible, and all vessels must be scalded every time they are used.

3. The casein in cow's milk forms the chief hindrance to its digestion by the infant. The milk must therefore be **diluted** by adding two parts of boiled water to one of milk for young children, and one part of water to one of milk, after the first four or five months. If a heavy curd still forms, a little lime water should be added, or barley water may be used as the diluent instead of water.[1] But sufficient dilution to render the casein digestible reduces the fat and the sugar unduly, and to begin with, mother's milk contains more sugar than cow's milk.

4. Therefore **sugar**, preferably milk sugar, must be added in making up the bottle.

5. The necessary amount of fat should be secured by the addition of **cream**.

It is to be hoped that before long there will be in every town a dairy which will bring, from properly supervised farms, milk carefully cooled and sealed up. By the use of separators, cream and separated milk of standard composition will be obtained. The dairy will undertake the preparation daily, from the physician's prescription, of sterile infants' food of definite composition, using separated

[1] ʒi of pearl barley to a pint of water, stir slowly for 3 or 4 hours, and make up the quantity again to a pint, strain through muslin and allow to cool. This is not in any way intended to act as food, but simply as a mechanical hindrance to the formation of curd.

milk, cream, water, and sugar of milk. Such dairies are working well in Copenhagen, Boston and elsewhere.[1]

Most children easily digest Milk, ℥i, Diluent, ℥ii, Cream, ʒii, Sugar, ʒss, given in suitable quantities, and at suitable times. Barley water, or boiled water with one fourth lime water, may be used as the diluent, and the proportions may be varied according to age and digestive powers. A pinch of carbonate of soda may be added to restore slight alkalinity to the mixture. If curds are thrown up, the milk may be left out for a time or reduced in quantity. As time goes on, more milk and less diluent may be used, till, at the 5th or 6th month, equal quantities are being given, and, later, two parts of milk to one of water.

Starchy food.—Before the teeth appear the child does not secrete enough amylolytic ferment to digest any starchy food. When dentition has begun, however, a teaspoonful of one of the malted or dextrinised foods, well boiled, may be added to the bottle twice daily. The quantity is gradually increased, till, when it is about a year old, the child may have light starchy food which has not been previously converted into sugar by the action of amylolytic ferments. Peptonised proteid foods should not be used in health, but are useful in some cases of disease and malnutrition.

Condensed Milk.—Most condensed milk has sugar added to it, and cream removed from it in preparation. It is not a satisfactory food for any length of time, though it is sometimes tolerated when fresh milk is not. For the poor in towns who cannot possibly obtain pure milk it has the great advantage of being practically sterile and of uniform composition. Unsweetened condensed milk, with a little sugar added, is better than that preserved by the addition of sugar, but it does not keep long after the tin is opened. One part of condensed milk to nine parts of water is the

[1] Ashby, Manchester Medical Society, Feb. 1896, on Milk and Infantile Disease.

proper medium strength, weaker for very young children, and stronger for those past the 6th month.

Times and Quantities.—First week, ℥i every 2 hours. Next 5 weeks, ℥i to ℥iss every 2 to 3 hours. Thereafter add ℥i to each meal every month, and feed at gradually lengthened intervals till the 8th month, after which 5 meals daily are enough. Just as when nursed by the mother, the hand-fed baby should be trained from the first to sleep 3 hours together during the night, and before it is a year old it should be able to spend 7 hours every night in undisturbed repose.

Solid food.—When the child has got most of its teeth it is a great mistake to deny it solid food, though the statement is true that, till the end of the second year, the chief food should be milk. Eggs, fish and digestible meat may be gradually allowed in small quantities, with vegetables, soups, and all the farinaceae. Feeding children on starch, under its various disguises, makes them fat, flabby and stupid, and sadly checks both bodily and mental development.

INDEX.

PAGE

ABDOMINAL Pregnancy . 144
Abortion 160
Abscess in ectopic gestation 138, 141, 150
Abscess of mamma . . 461
Acardiac monster . . 93
Accidental haemorrhage . 342
After-coming head . . 323
,, impaction of . . . 325
,, perforation of . . 438
After pains 458
Ague 107
Air embolism . . . 371
Albuminuria . . . 120
Allantois . . . 61, 73
Amenorrhoea . . . 23
Amnion . . . 60, 71
Amputations . . . 157
Anaemia 114
Anaesthesia . . . 272
Anasarca 115
Anencephalic monster . . 311
Anteflexion . . . 127
Anteversion . . . 127
Antiseptics . . 257, 262
Anus in labour . . . 183
Apnoea 384
Apoplectic ovum . . 155
Arbor vitae . . . 8
Area germinatina . . 58
,, pellucida . . . 58
,, vasculosa . . . 58
Areola 41
Arm presentation . . 327
,, upward displacement . 324
Armamentarium . . . 257
Arterial transfusion . . 361
Articulations, pelvic . . 202
Artificial feeding . . . 471
,, respiration . . . 385
Ascites 115
,, foetal 310

PAGE

Asphyxia 384
Atresia 279
Attitude foetal . . . 88
Axis of pelvis . . . 199
Axis-traction . . . 397
,, rods 402
,, forceps 404
,, action of . . . 407

BAG, Barnes' . . . 428
,, De Ribes' . . . 429
,, of membranes . . 179
Ballottement . . . 48
Bandl's ring . . 185, 241
Basilyst 436
Battledore placenta . . 79
Bimanual examination . 47
Binder 272
Bipolar version . . . 391
Bladder in pregnancy . 41, 119
,, in labour . . 230, 285
Blastoderm . . . 58
Blood in pregnancy . . 43
Blunt Hook . . . 439
Breech 317
Broad ligament . . . 6
,, at end of pregnancy . 320
Bronchitis 117
Brow presentation . . 312

CAESARIAN section . . 441
Calcareous degeneration 138, 159
Calculus, vesical . . . 285
Cancer in pregnancy . . 125
Caput succedaneum . . 225
Carcinoma 125
Cardiac disease . . . 115
,, in labour . . . 369
Caries 293
Carneous mole . . . 155
Carunculae 2

PAGE
Caul 180
Catheter . . . 257, 263
Cellulitis 453
Centres for uterus . . 190
Cephalhaematoma . . 437
Cephalic version . . 390
Cephalotomy . . . 434
Cephalotribe . . . 434
Cervix, structure . . . 8
,, shortening of . . 32
,, atresia of . . . 279
,, dilatation of . . 178, 282
Chamberlen . . . 394
Champetier de Ribes' bag . 429
Child in utero . . . 81
Chloral . . . 264, 279
Chloroform . . . 272
Chorea 112
Chorion . . . 60, 71
,, villi of 68
,, diseases of . . . 151
Cicatrices 284
Circulation, placental . . 77
,, foetal 83
Cleavage of blastoderm . 59
Clitoris 1
Coccyx 290
Cold in haemorrhage . . 355
Colostrum 468
Complex labour . . . 333
Concealed haemorrhage . 342
Conception . . 26, 30
Conjugate . . . 203, 195
Constipation . . . 118
Contracted pelvis . . 287
Contraction, uterine . . 187
Convulsions . . . 372
Cord 73
,, diseases of . . . 157
Corpus luteum, pregnancy . 40
,, menstruation . . 18
Cranial presentation . . 207
Cranioclast 435
Craniotomy . . . 432
Crédé 269
Crotchet 436
Curette 170
Cycle, menstrual . . 10
Cystic tumours . . . 52
Cysts of placenta . . 155
Cystocele 285

PAGE
DEATH of foetus . . . 159
,, in ectopic pregnancy . 137
Death, sudden . . . 370
Decapitation . . 331, 383
Decidua 36
,, relation of ovum to . 66
,, in ectopic gestation . 134
Deformities, pelvic . . 287
,, of foetus . . 159, 310
Degeneration of decidua . 39
,, of villi 138
Delivery, normal . . 185
Development of ovum . . 57
Diabetes 122
Diagonal conjugate . . 202
Diameters of pelvis . . 195
,, of head 206
Diarrhoea 178
Diet, pregnancy . . . 103
,, puerperium . . . 449
,, infancy 471
Digestion, pregnancy . . 117
Dilators, Hegar's . . 168
,, Barnes' 428
,, Champetier de Ribes' . 429
Diphtheria, pregnancy . 107
,, puerperium . . . 456
Diseases of pregnancy . . 103
,, puerperium . . . 450
Dislocations, congenital . 290
,, in labour . . . 389
Displacements of uterus . 125
Double uterus . . . 131
Douche 257
Dropsy in pregnancy . . 115
Ductus arteriorus . . 84
,, venosus . . . 84
Dyspnoea 116
Dysuria in pregnancy . . 119
,, after labour . . . 459

ECLAMPSIA . . 120, 372
Ecraseur 434
Elbow 327
Elytrotomy 445
Embolism 371
Embryo . . . 59, 81
Embryotomy . . . 439
Emotion in abortion . . 161
,, in lactation . . . 469
Emphysema . . 282, 372

PAGE
Emphysema, foetal . . 309
Encephalocele . . . 310
Endocarditis . . 116, 371
Endometritis . . . 124
Enema . . . 257, 261
Enteric fever . . . 103
Enterocele 285
Epiblast . . . 56-63
Epidemics 105
Epilepsy . . . 112
Epistaxis 114
Epithelium . . . 56-63, 66
Ergot 258, 271
Erysipelas 107
Eustachian valve . . 83
Evisceration . . . 331
Evolution of forceps . . 394
,, spontaneous . . . 328
Examination for pregnancy . 45
,, in labour . . . 259
Exanthemata . . . 105
,, in puerperium . . 452
Excoriation, nipple . . 460
Exhaustion 277
Exomphalos . . . 311
Exostosis 308
Expression of child . 267, 320
,, of placenta . . . 269
Extension 219
External rotation . . 220
Extra-uterine pregnancy . 134
Extroversion . . . 311

FACE presentation . . 313
Fallopian tubes . . . 10
False pains 178
Feeding of infant . . 468
Fever in pregnancy . . 105
,, puerperal . . . 450
Fibroid tumour . . . 125
Fillet 394
Fissured nipples . . . 460
Fistula 367
Fits, epileptic . . . 112
,, eclamptic . . . 372
Flat pelvis 301
Flexion 214
Fluid pressure . . . 192
Foetal attitude . . . 88
,, head 204
,, circulation . . . 83

PAGE
Foetal heart . . . 49
,, movements . . . 48
,, parts 48
Foetation, ectopic . . 134
Follicles, Graafian . . 13
Fontanelle 205
Foot 318
Forceps 394
Fossa navicularis . . . 2
Fourchette 2
Fractures 325
Funic souffle . . . 49
Funis 73
Funnel-shaped pelvis . . 289

GALACTOCELE . . . 461
Galactorrhoea . . . 460
Ganglion 10
Germinal spot . . 19, 57
,, vesicle . . . 19, 57
,, area 58
Glycosuria 122
Graafian follicle . . . 13
Gravid uterus . . . 32
,, contents of . . . 71

HAEMATOCELE . 114, 143, 147, 148
Haematoma . 114, 147, 368
Haematometra . . . 51
Haemophylia . . . 114
Haemoptysis . . . 114
Haemorrhoids . . . 116
Haemorrhage . . . 333
,, during pregnancy . 114, 124
,, during labour . . 333
,, accidental . . . 342
,, unavoidable . . . 334
,, post-partum . . . 350
,, secondary . . . 462
Hand feeding . . . 471
Head, foetal . . . 204
Heart disease in pregnancy . 115
,, in labour . . . 369
Heart, foetal . . 49, 83
Hegar's dilators . . . 168
Hemiplegia . . . 112
Hernia of uterus . . 129
Hook, blunt . . . 439
Hour-glass contraction . 348
Hydatid mole . . . 151

PAGE
Hydramnios . . . 153
Hydrocephalus . . . 310
Hydrocele 310
Hydrometra . . . 51
Hydrorrhoea . . . 123
Hydrothorax . . . 310
Hygiene of pregnancy . 103
,, infancy 467
Hymen 2, 53
Hypoblast 58
Hysteria 112
Hysterectomy . . . 443

ICE, in haemorrhage . . 355
Icterus 119
Impregnation . . . 25
Incarceration of uterus . 128
,, of foetus . . . 138
Incision of cervix . . 279
Induction of abortion . . 431
,, labour 426
Inertia uteri . . . 283
Injection of glycerine . . 428
Insanity of pregnancy . . 111
,, puerperium . . . 464
Insomnia 113
Intermittent fever . . 106
Internal rotation . . . 217
Intoxication . . . 217
Inversion of uterus . . 368
Involution 446
Irregular contraction . . 178

JAUNDICE 119
Jaw traction . . . 323
Joints of pelvis . . . 200

KIDNEY disease . . . 120
Kyestine 44
Knee 318
Knots 77, 157
Kyphotic pelvis . . . 299

LABIA 1
Labour, anatomy . . 229
,, classification . . . 175
,, clinical phenomena . 176
,, complex . . . 333
,, factors 187
,, instrumental . . . 187
,, laborious . . . 277

PAGE
Labour, mechanism . . 213
,, management . . . 256
,, praeternatural . . 317
Lacerations, cervix . . 364
,, vagina 364
,, perineum . . . 365
Lactation 467
Laparo-elytrotomy . . 445
Laparotomy . . . 440
Lateral obliquity, head 211, 238
,, uterus 33
Leucorrhoea . . 23, 123
Length of foetus . . 81, 100
Lever 394
Ligature of funis . . 268
Liquor amnii . . 72, 153
Lithopaedion . . . 138
Liver 119
Lochia 447
Locking forceps . . . 419
Locked twins . . . 383
Lordosis 302
Lymphatics of uterus . . 9

MACERATION . . . 159
Malacosteon . . 292, 306
Malaria 107
Malformations of uterus . 130
,, of foetus . . . 310
Malposition of uterus . . 131
,, of foetus . . 158, 311
Malpresentation . . . 312
Mamma in pregnancy . . 41
,, in diagnosis . . . 46
,, in puerperium . . 46
,, abscess of . . . 461
Mania 111
Marginal insertion . . 74
Marriage, age for . . 26
,, in syphilis . . . 109
,, in tuberculosis . . 107
,, heart disease . . . 115
Mastitis 461
Measles 107
Mechanism, normal vertex . 213
,, pelvic presentation . 319
,, face presentation . . 313
,, transverse ,, . . 328
,, justo-minor . . . 295
,, flat pelvis . . . 304
,, occipito-posterior . . 221

PAGE
Mechanism, mento-posterior 314
Meconium 86
Melancholia . . . 111
Membranes, development . 60
,, structure . . . 71
,, diseases . . 151, 153
,, bag of 179
,, rupture of . . . 180
,, adhesion of . . . 281
Meningocele . . . 310
Menstruation, phenomena . 20
,, theories of . . . 27
Mesoblast 58
Metritis 124
Micrococci 450
Milk, cow's . . . 472
,, condensed . . . 474
Miscarriage . . . 160
Missed abortion . . . 163
Missed labour . . . 159
Mitral stenosis . . 115, 370
Mole, carneous . . . 155
,, hydatid . . . 151
Monster, acardiac . 93, 383
,, anencephalic . . . 311
,, double 383
Mons veneris . . . 1
Montgomery's tubercles 41, 46
Morning sickness . 44, 117
Moulding of head, vertex . 225
,, in face cases . . . 314
Movements, foetal . 48, 86
Mucosa, normal uterine . 7
,, of pregnancy . . 36, 67
Multiple pregnancy . 90, 381
Mummification . . . 138
Muscles in labour . . 191
Myoma 125
Myxoma . . . 153, 155

NAEGELE obliquity . . 211
,, pelvis 298
Nausea 117
Nephritis . . . 120, 374
Nerves . . . 10, 35
Nervous system . . . 111
Neuralgia 113
Neuroses 112
Nipple in pregnancy . 41, 103
,, puerperium . . . 447
Nullipara 53

PAGE
Nurse, wet- . . . 471
Nutrition of foetus . . 85

OBLIQUITY of uterus . . 33
,, of head 210
Obliquely contracted pelvis . 296
Occiput 206
Occipito-posterior . 221, 311
Oedema 123
,, of foetus . . . 310
Ophthalmia neonatorum . 272
Os, occlusion of . . . 279
Osteo-malacia . . 292, 306
Ovary 11
Ovarian pregnancy . . 144
,, tumours . . . 285
Ovulation 17
Ovum 13
,, development of . . 57

PAIN 177
Pains, after- . . . 458
,, false 178
Paralysis . . . 111, 282
Parametritis . . . 453
Parity, diagnosis . . . 53
Parovarian tumours . . 285
Passenger 203
,, causing delay, 1st stage . 280
,, ,, 2nd stage 308
Pelvimetry 201
Pelvic cellulitis . . . 453
,, peritonitis . . . 454
,, presentation . . . 317
Pelvis, normal . . . 194
,, causes of contracted . 288
,, types of contracted . 294
,, justo-major . . . 294
,, justo-minor . . . 295
,, generally contracted rickety . . . 295
,, scolio-rachitic . . 296
,, Naegele . . . 298
,, kyphotic . . . 299
,, Robert 300
,, infantile . . . 300
,, simple flat . . . 301
,, split 301
,, spondylolisthetic . . 301
,, rickety flat . . . 303
,, malacosteon . . . 306

PAGE
Vertex 206
,, presentation . . . 209
Vesicle, germinal . . . 13
,, umbilical . . . 73
Vesico-vaginal fistula . . 367
Villi, development . . 62
,, structure . . . 77
Vomiting 117
Vulva 1
,, lacerations . . . 365
,, pruritus 122
,, oedema 123
Vulva, narrowness . . . 284

WEANING 466
Weight of foetus . . . 13
Wet-nurse 471

YOLK 64

ZONA pellucida . . . 13, 37
Zymotic diseases—
in pregnancy . . . 105
in puerperium . . . 456

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